MATHEMATICS 13

EXAMPLES OF STUDENTS' RESPONSES

CLASSROOM
ASSESSMENT
MATERIALS

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Alberta
EDUCATION

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Introduction

Purpose

The purpose of this document is to provide teachers, students, parents, and administrators with examples of students' responses that illustrate the provincial standards expected of students who complete Mathematics 13.

Contents

For each of the written or performance tasks, the Examples of Students' Responses document contains

- the student task
- the sample answers and scoring criteria to be used by teachers to evaluate their students' work (these can also be found in the Teacher Manual)
- examples of students' responses at each criteria "level"
- commentaries that illustrate and explain how the scoring criteria fit each response.

Each student response in this document is reproduced as it appeared in the assessment; that is, in the students' own handwriting. Because of space limitations, the planning and drafting that may have preceded or accompanied some of the responses may not have been included. However, teachers and other readers should note that research has demonstrated a very strong relationship between the quality of planning and the degree of success in written expression.

Selection of Examples

The students' responses in this document were selected from those produced during the pilot testing of the Classroom Assessment Materials Project in May and June of 1996. A committee composed of Mathematics 13 teachers from different parts of the province reviewed and validated the assessments and scoring criteria, then selected students' responses.

These examples of students' work illustrate the provincial standards for students who complete Mathematics 13.

Considerations

Please note that

- the examples presented illustrate specific standards (scoring criteria), but are not necessarily typical of the responses submitted
- the selected responses represent only a few of the possible approaches to each task. None of the examples is intended to serve as a model of a particular approach
- you should consider each student example in light of the constraints of the assessment situation. Under assessment conditions, most students are able to prepare responses that must be considered as first draft only

Contents

In addition to this *Examples of Students' Responses*, the Mathematics 13 Classroom Assessment Materials include a complete set of *Student Materials* and a *Teacher Manual*.

Mathematics 13

End-of-Course Exam

- ***Written Response 1***
- ***Written Response 2***

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Scoring Criteria for Written Responses 1 and 2

Mark	Scoring Criteria
5	*The student* • provides a correct and complete solution • demonstrates an understanding of the concepts and procedures related to the task • provides communication that is clear, understandable, and logically organized
4	*The student* • provides a complete solution with a few minor errors • demonstrates an understanding of the major concepts and procedures, although a small part may be missing or contain minor errors • provides communication that is understandable and logically organized but may contain a flaw or lack some clarity
3	*The student* • provides a complete response that demonstrates a correct major step in the solution to the problem • demonstrates some correct support or understanding of the major step • communicates understandable reasons for solutions
2	*The student* • provides a partial solution that is complete and correct • demonstrates some support and/or understanding for the partial solution • provides communication that is consistent with the task
1	*The student* • makes a significant start that could have led to the successful conclusion of a major step • provides a correct answer with no supporting work **or** provides a statement or procedure that shows some understanding of the process or steps involved • provides communication that is inadequate to the task
0	*The student* • presents work that is off topic • presents a blank paper

Note: Minor error means
- calculation error
- communication error
- missing or incorrect units, where applicable
- reasoning/logic error

Written Response 1

Student Task and Solution

Use the following information to answer the next question.

Bart is planning to refinish a wall, by either wallpapering or texture-painting it. The wall measures 4.9 m by 2.3 m and will be covered completely.

A roll of wallpaper costs \$15.85 and covers an area of 2.5 m^2. Texture paint is sold in a 4 L container, which covers 4.2 m^2 and costs \$23.50. Assume that wallpaper comes in **full** rolls only and that texture paint can be bought only in **full** 4 L containers.

Written Response – 5 marks

1. What is the most economical way for Bart to refinish the wall? Support your **answer** with calculations showing the actual cost of refinishing the wall both ways.

A SOLUTION

Surface area of wall: $4.9\text{ m} \times 2.3\text{ m} = 11.27\text{ m}^2$

Method I—Wallpaper

Number of rolls: $\dfrac{11.27\text{ m}^2}{2.5\text{ m}^2\text{ / roll}} = 4.51$ rolls

$\therefore$ 5 rolls need to purchased

Cost of wallpaper:

$5\text{ rolls} \times \dfrac{\$15.85}{\text{roll}} = \$79.25$

Method II—Texture Paint

Number of 4 L cans: $\dfrac{11.27\text{ m}^2}{4.2\text{ m}^2\text{ / L}} = 2.68\text{ L}$

$\therefore$ 3 cans of paint need to be purchased

Cost of texture paint:

$3\text{ rolls} \times \dfrac{\$23.50}{\text{roll}} = \$70.50$

Texture-painting the wall will be more economical because wall paper costs \$75.25 and texture paint costs \$70.50.

Student Examples

This response would receive a score of **5**

Scoring Criteria

The student

- provides a correct and complete solution
- demonstrates an understanding of the concepts and procedures related to the task
- provides communication that is clear, understandable, and logically organized

Use the following information to answer the next question.

Bart is planning to refinish a wall, by either wallpapering or texture-painting it. The wall measures 4.9 m by 2.3 m, and will be covered completely.

A roll of wallpaper costs \$15.85 and covers an area of 2.5 m^2. Texture paint is sold in a 4 L container, which covers 4.2 m^2 and costs \$23.50. Assume that the wallpaper comes in **full** rolls only, and that texture paint can be bought only in **full** 4 L containers.

Written Response – 5 marks

1. What is the cheapest way for Bart to refinish the wall? Support your answer with calculations showing the actual cost of refinishing the wall both ways.

area of wall = $4.9m \times 2.3m = 11.27m^2$

wallpaper: $\frac{11.27m^2}{2.5m^2} = 4.508$ so 5 rolls

5 rolls $\times \$15.85 = \$79.25$

texture paint: $\frac{11.27m^2}{4.2m^2} = 2.68$ so 3 cans

3 cans $\times \$23.50 = \$70.50$

The cheapest way for Bart to refinish the wall would be to texture paint it. This is because the wallpaper would cost \$79.25 while the paint is \$70.50.

Commentary

The student's

- response is complete, correct, and clearly communicated. The procedure is clearly labelled and easy to follow
- answers are calculated correctly, and include proper units and mathematical syntax
- final statement answers the question and is an example of clear and effective communication

This response would receive a score of **4**

Scoring Criteria

The student

- provides a complete solution, with a few minor errors
- demonstrates an understanding of the major concepts and procedures, although a small part may be missing or contain minor errors
- provides communication that is understandable and logically organized, but may contain a flaw or lack some clarity

Use the following information to answer the next question.

Bart is planning to refinish a wall, by either wallpapering or texture-painting it. The wall measures 4.9 m by 2.3 m, and will be covered completely.

A roll of wallpaper costs \$15.85 and covers an area of 2.5 m^2. Texture paint is sold in a 4 L container, which covers 4.2 m^2 and costs \$23.50. Assume that the wallpaper comes in **full** rolls only, and that texture paint can be bought only in **full** 4 L containers.

Written Response – 5 marks

1. What is the cheapest way for Bart to refinish the wall? Support your answer with calculations showing the actual cost of refinishing the wall both ways.

Wallpaper

A= L×W
A= 4.9 x 2.3
A=11.3

11.3÷2.5
= 4.52.

you would need 5 rolls so
15.85 x 5 = 79.25 it would cost
\$79.25 to wallpaper.

Texture Paint

11.3÷4.2=2.7.

you would need 3 cans of paint
so 23.50 x 3 = 70.5
it would cost \$70.50 to
texture paint.

Answer

40

It is cheapest to texture paint than to wallpaper because to texture paint it is \$70.50 and to wallpaper it is \$79.25 so by texture painting you save \$8.75.

Commentary

The student's

- response includes all parts of the question, and if an explanation had been provided on how "4.52" and "2.7" are linked to 5 rolls and 3 cans, the response would have received a score of 5
- work illustrates an understanding of the concepts and procedures used to determine area, ratios, and rounded values
- communication is effective and the final statement is clear and well-supported, although the response includes a minor error in that some units are missing ("11.3" instead of "11.3 m^2")

This response would receive a score of **3**

Scoring Criteria

The student

- provides a complete response that demonstrates a correct major step in the solution to the problem
- demonstrates some correct support or understanding of the major step
- communicates understandable reasons for solutions

Use the following information to answer the next question.

Bart is planning to refinish a wall, by either wallpapering or texture-painting it. The wall measures 4.9 m by 2.3 m, and will be covered completely.

A roll of wallpaper costs \$15.85 and covers an area of 2.5 m^2. Texture paint is sold in a 4 L container, which covers 4.2 m^2 and costs \$23.50. Assume that the wallpaper comes in **full** rolls only, and that texture paint can be bought only in **full** 4 L containers.

Written Response – 5 marks

1. What is the cheapest way for Bart to refinish the wall? Support your answer with calculations showing the actual cost of refinishing the wall both ways.

Wall 4.9m by 2.3m = 11.27m^2

$\frac{11.27m^2}{2.5m^2}$ = 4.508 × \$15.85 = \$71.45 18

$\frac{11.27m^2}{4.2m^2}$ = 2.683 × \$23.50 = \$63.0505

To refinish the wall with wallpaper would cost \$71.45 which would be more expensive than the texture paint, which is only \$63.05, and it covers a larger area than the wallpaper.

Commentary

The student's

- response is complete, contains a major step in the solution of the problem, and the necessary calculations are provided, although rounding to full rolls and full cans is not done
- work illustrates an understanding of ratios, but the phrase "covers a larger area" indicates incomplete understanding of conceptual knowledge related to area
- communication is understandable but lacks clarity (i.e., The student does not identify the steps involving calculations regarding wallpaper or texture paint)

This response would receive a score of **2**

Scoring Criteria

The student

- provides a partial solution that is complete and correct
- demonstrates some support and/or understanding for the partial solution
- provides communication that is consistent with the task

Use the following information to answer the next question.

Bart is planning to refinish a wall, by either wallpapering or texture-painting it. The wall measures 4.9 m by 2.3 m, and will be covered completely.

A roll of wallpaper costs \$15.85 and covers an area of 2.5 m^2. Texture paint is sold in a 4 L container, which covers 4.2 m^2 and costs \$23.50. Assume that the wallpaper comes in **full** rolls only, and that texture paint can be bought only in **full** 4 L containers.

Written Response – 5 marks

1. What is the cheapest way for Bart to refinish the wall? Support your answer with calculations showing the actual cost of refinishing the wall both ways.

$4.9 \times 2 + 2.3 \times 2 = 14.4^2$

$\frac{14.4^2}{2.5^2} = 5.75 = \cancel{6} \times 15.85$ 95.1

$\frac{14.4^2}{4.2^2} = 3.42 = 4 \times 23.50$ 95.1 + 94 = 1

it will cost 189.1

Commentary

The student's

- response is a partial solution in that the calculations are complete with minor errors (finds perimeter instead of area, total cost instead of cheapest cost, and the units are missing), and a final incorrect answer is stated with no supporting detail
- calculations demonstrate an understanding of ratios and of determining total cost, although the illustration of the process is sparse
- understanding of area lacks clarity and appears to be incorrect
- communication provides enough information to support the solution, but syntax errors (i.e., "14.42" instead of "14.4 m^2") and incomplete identification of the steps involving calculations are evident

This response would receive a score of ***1*** ***(Example 1)***

Scoring Criteria

The student

- makes a significant start that could have led to the successful conclusion of a major step
- provides a correct answer with no supporting work **or** provides a statement or procedure that shows some understanding of the process or steps involved
- provides communication that is inadequate to the task

Use the following information to answer the next question.

Bart is planning to refinish a wall, by either wallpapering or texture-painting it. The wall measures 4.9 m by 2.3 m, and will be covered completely.

A roll of wallpaper costs \$15.85 and covers an area of 2.5 m^2. Texture paint is sold in a 4 L container, which covers 4.2 m^2 and costs \$23.50. Assume that the wallpaper comes in **full** rolls only, and that texture paint can be bought only in **full** 4 L containers.

Written Response – 5 marks

1. What is the cheapest way for Bart to refinish the wall? Support your answer with calculations showing the actual cost of refinishing the wall both ways.

The cheapest way for Bart to refinish his wall would be to paint.

Commentary

The student's

- response is significant in that a correct answer with no supporting work is provided

This response would receive a score of ***1*** ***(Example 2)***

Scoring Criteria

The student

- makes a significant start that could have lead to the successful conclusion of a major step
- provides a correct answer with no supporting work **or** provides a statement or procedure that shows some understanding of the process or steps involved
- provides communication that is inadequate to the task

Use the following information to answer the next question.

Bart is planning to refinish a wall, by either wallpapering or texture-painting it. The wall measures 4.9 m by 2.3 m, and will be covered completely.

A roll of wallpaper costs \$15.85 and covers an area of 2.5 m^2. Texture paint is sold in a 4 L container, which covers 4.2 m^2 and costs \$23.50. Assume that the wallpaper comes in **full** rolls only, and that texture paint can be bought only in **full** 4 L containers.

Written Response – 5 marks

1. What is the cheapest way for Bart to refinish the wall? Support your answer with calculations showing the actual cost of refinishing the wall both ways.

Wall 4.9 X 2.3m = 11.27m

wallpaper 2.5m² X 11.27m = 56.35 X 15.85
X = \$93.14

Texturepaint

Commentary

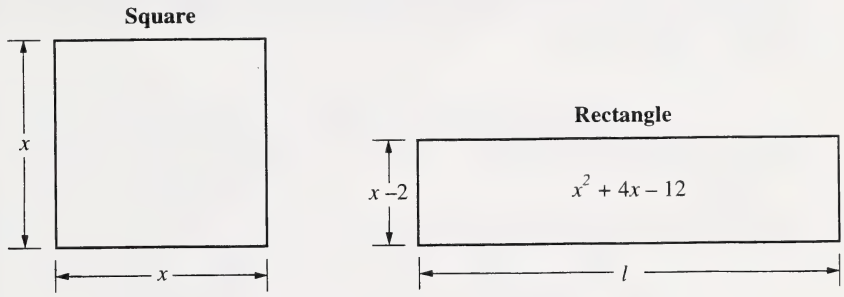
The student's

- response is a significant start in that the area is calculated correctly and would have led to the development of a major step if continued correctly

Written Response 2

Student Task and Solution

Kelly's project requires her to change the design of a label, from a square whose side is x centimetres, to a rectangle with a shortened width of$(x - 2)$ cm and area of $(x^2 + 4x - 12)$ cm^2, as shown below.



Written Response – 5 marks

2. **a.** Kelly takes the first steps to find the length, l, of the rectangle in terms of x centimetres, by factoring the area of the rectangle. Complete her work and state the length.

$$\begin{aligned} \text{Area} &= lw \\ A &= x^2 + 4x - 12 \\ A &= (\qquad)(x - 2) \end{aligned}$$

A SOLUTION

If the area is equal to the length times the width, and the width is equal to $(x - 2)$ cm, then $(x + 6)$ is the length of the rectangle in centimeters.
Area = $\mathbf{(x + 6)}(x - 2)$.
The length of the rectangle is $(x + 6)$ cm.

b. Kelly compares the length of the rectangle to a side of the square. State the difference between the length of the rectangle and the length of a side of the square.

A SOLUTION

The length of the rectangle is 6 cm longer than a side of the square.

c. Kelly is told that the **areas** of the two labels have to be equal. She correctly determines that this will occur when $x = 3$. Explain why her reasoning is correct, and demonstrate that the areas would be different for other values of x.

A SOLUTION

Part 1 Kelly is correct, because when the value of $x = 3$ is selected the dimensions of the square are $3 \text{ cm} \times 3 \text{ cm}$ and the dimensions of the rectangle are $9 \text{ cm} \times 1 \text{ cm}$, both giving an area of 9 cm^2.

OR Kelly is correct, because the area of the square is x^2 and the area of the rectangle is $x^2 + 4x - 12$, and both areas are equal to 9 cm^2 space when a value of $x = 3$ is substituted.

Part 2 Values of x that yield areas that are different are illustrated in the table below.

	Square	**Rectangle**
x (cm)	x^2 (cm^2)	$x^2 + 4x - 12$ (cm^2)
4	16	20
5	25	33
6	36	48
N	N^2	$N^2 + 4N - 12$

Student Examples

This response would receive a score of **5**

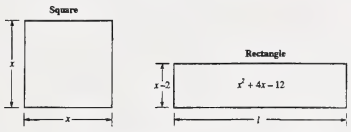
Scoring Criteria

The student

- provides a correct and complete solution
- demonstrates an understanding of the concepts and procedures related to the task
- provides communication that is clear, understandable, and logically organized

Use the following information to answer the next question.

Kelly's project requires her to change the design of a label, from a square whose side is x centimetres, to a rectangle with a shortened width of $(x-2)$ cm and area of $(x^2+4x-12)$ cm^2, as shown below.



Written Response – 5 marks

2. a. Kelly takes the first steps to find the length, l, of the rectangle in terms of x centimetres, by factoring the area of the rectangle. Complete her work and state the length.

Area = lw
$A = x^2+4x-12$
$A = (x+6)(x-2)$

$\boxed{\text{length} = x+6}$

I factored the question and got $(x+6)(x-2)$. The diagram tells me that the width is $x-2$, so the length must be $x+6$, since to find area you must multiply length and width, which is what $(x+6)$ and $(x-2)$ are doing.

b. Kelly compares the length of the rectangle to the side of the square. State the difference in length of the rectangle to the side of the square.

The length of the rectangle = $x+6$ and the side of the square = x. So, the length of the rectangle is 6 cm longer than the side of the square.

c. Kelly is told that the areas of the two labels have to be equal. She correctly determines that this will occur when $x = 3$. Explain why her reasoning is correct, and demonstrate that the areas would be different for other values of x.

If you replace x with 3 the square's area is $3 \times 3 = 9$cm^2 and the rectangle is also 9cm^2.

$(x-2)(x+6) = (3-2)(3+6) =$
$(1)(9) = 9$cm^2

If I replace x with 2 the square is $2 \times 2 = 4$cm^2, and the rectangle is $(2-2)(2+6) = 8$cm^2 so the two areas are different, 4cm^2 and 8cm^2.

You have now completed the pilot test.
If you have time, you may wish to check your answers.

Commentary

The student's

- response is complete, correct, and clearly communicated (a counter example is used to defend a correct example in Part C); all calculations are correct, and final statements are well-supported and conclusive

This response would receive a score of **4**

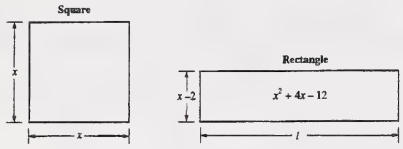
Scoring Criteria

The student

- provides a complete solution with a few minor errors
- demonstrates an understanding of the major concepts and procedures, although a small part may be missing or contain minor errors
- provides communication that is understandable and logically organized, but may contain a flaw or lack some clarity

Use the following information to answer the next question.

Kelly's project requires her to change the design of a label, from a square whose side is x centimetres, to a rectangle with a shortened width of $(x-2)$ cm and area of $(x^2+4x-12)$ cm^2, as shown below.



Written Response – 5 marks

2. a. Kelly takes the first steps to find the length, l, of the rectangle in terms of x centimetres, by factoring the area of the rectangle. Complete her work and state the length.

Area $= lw$
$A = x^2+4x-12$
$A = (x+6)(x-2)$
$A = x+6$

∴ The length is $(x+6)$ cm.

b. Kelly compares the length of the rectangle to the side of the square. State the difference in length of the rectangle to the side of the square.

$\frac{x+6 \text{ (length)}}{x \text{ (side of square)}} = +6$

∴ The length of the rectangle is +6 larger than the side of the square.

$x+6 > x$

c. Kelly is told that the **areas** of the two labels have to be equal. She correctly determines that this will occur when $x = 3$. Explain why her reasoning is correct, and demonstrate that the areas would be different for other values of x.

x	Area Rec	Area Square
2	0	4
5	33	25
7	65	49
3	9	9

Rectangle: $x^2+4x-12$
$(2)^2+4(2)-12$
$4+8-12$
$12-12=0$

$(5)^2+4(5)-12$
$25+20-12$
$45-12=33$

$(7)^2+4(7)-12$
$49+28-12$
$77-12=65$

$(3)^2+4(3)-12$
$9+12-12$
$21-12=9$

Square: x^2
$(2)^2$
4

x^2
$(5)^2$
25

x^2
$(7)^2$
49

x^2
$(3)^2$
9

∴ Using $x=3$ is the only value that will equal out the 2 solutions. (9)

Commentary

The student's

- response is complete and correct for all parts of the question, and the assessment would have been higher if a reasoning error had not occurred in Part B
  (i.e., "$\frac{x+6}{x}$" does not equal "6" or describe the difference)
- illustrates an understanding of the concepts and procedure used to find factors and solve equations, although a flaw exists in understanding the difference between algebraic terms
- communication is effective (i.e., counter examples are used to defend a correct example in Part C), although units are missing in Part B and "$x+6>x$" is unnecessary
- final statements are clear and well-supported.

This response would receive a score of **3**

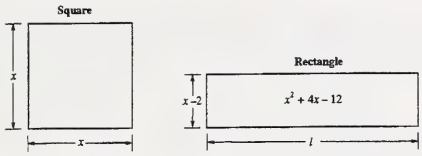
Scoring Criteria

The student

- provides a complete response that demonstrates a correct major step in the solution to the problem
- demonstrates some correct support or understanding of the major step
- communicates understandable reasons for solutions

Use the following information to answer the next question.

Kelly's project requires her to change the design of a label, from a square whose side is x centimetres, to a rectangle with a shortened width of $(x-2)$ cm and area of $(x^2+4x-12)\ \text{cm}^2$, as shown below.



Written Response – 5 marks

2. **a.** Kelly takes the first steps to find the length, l, of the rectangle in terms of x centimetres, by factoring the area of the rectangle. Complete her work and state the length.

$$\text{Area} = lw$$
$$A = x^2+4x-12$$
$$A = (x+6)(x-2)$$

The length equals $(x+6)$

b. Kelly compares the length of the rectangle to the side of the square. State the difference in length of the rectangle to the side of the square.

Length of the rectangle = $(x+6)(x-2)$
Side of the square = x (-2)

c. Kelly is told that the areas of the two labels have to be equal. She correctly determines that this will occur when $x = 3$. Explain why her reasoning is correct, and demonstrate that the areas would be different for other values of x.

Areas have to be equal
$x = 3$

rectangle = $(x+6)(x-2)$
$= (3+6)(3-2)$
$= 9 \times 1$
$= 9$

square = x^2
$= 3^2$
$= 9$

This is the only number that will work out correctly. If you tried, it would end up the same as square.

It doesn't work out properly.

eg rect = $(x+6)(x-2)$
$= (4+6)(4-2)$
$= 10 \times 2$
$= 20$

eg square = x^2
$= 4^2$
$= 16$

Commentary

The student's

- response is complete and contains a major step in the solution to the problem; Parts A and C are answered correctly, but Part B is incomplete and contains an error (i.e., "$(x+6)(x-2)$" is used to describe length instead of $(x+6)$)
- work demonstrates an understanding of factoring and solving equations but the solution to Part B indicates poor understanding of the algebraic representations of length and area
- communication is understandable for Parts A and C, but Part B is incomplete and unclear

This response would receive a score of **2**

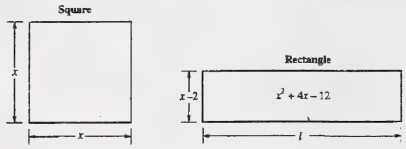
Scoring Criteria

The student

- provides a partial solution that is complete and correct
- demonstrates some support and/or understanding for the partial solution
- provides communication that is consistent with the task

Use the following information to answer the next question.

Kelly's project requires her to change the design of a label, from a square whose side is x centimetres, to a rectangle with a shortened width of $(x-2)$ cm and area of $(x^2+4x-12)\ \text{cm}^2$, as shown below.



Written Response – 5 marks

2. a. Kelly takes the first steps to find the length, l, of the rectangle in terms of x centimetres, by factoring the area of the rectangle. Complete her work and state the length.

$$\begin{aligned} \text{Area} &= lw \\ A &= x^2+4x-12 \\ A &= (x+6)(x-2) \\ A &= x+6 \end{aligned}$$

If you do factoring you will find that x-2 is the width and that x+6 would be the length

Continued

Continued

b. Kelly compares the length of the rectangle to the side of the square. State the difference in length of the rectangle to the side of the square.

the length is 2 times longer than that of the square so the length of the square would have to be x+3

X

c. Kelly is told that the **areas** of the two labels have to be equal. She correctly determines that this will occur when $x = 3$. Explain why her reasoning is correct, and demonstrate that the areas would be different for other values of x.

X

Seeing as the length of the rectangle is 2times as long as that of the square and that the height of the square is twice that of the rectangle you would divide the length by 2 giving you X=3

no other X value would work because 3 is the middle and if it was different it wouldn't be a square.

You have now completed the pilot test.
If you have time, you may wish to check your answers.

Commentary

The student's

- response is a partial solution in that Part A is answered correctly, and Parts B and C are attempted, though inadequately supported (i.e., the comparison of lengths in Part B based on measurements from the diagrams and the reasoning why "$x = 3$" in Part C are incorrect)
- response demonstrates an understanding of factoring and a partial understanding of algebraic representations
- communication provides enough information to support the solution provided in Part A

This response would receive a score of ***1***

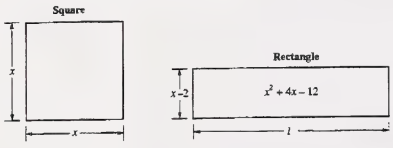
Scoring Criteria

The student

- makes a significant start that could have led to the successful conclusion of a major step
- provides a correct answer with no supporting work **or** provides a statement or procedure that shows some understanding of the process or steps involved
- provides communication that is inadequate to the task

Use the following information to answer the next question.

Kelly's project requires her to change the design of a label, from a square whose side is x centimetres, to a rectangle with a shortened width of $(x-2)$ cm and area of $(x^2+4x-12)$ cm^2, as shown below.



Written Response – 5 marks

2. a. Kelly takes the first steps to find the length, l, of the rectangle in terms of x centimetres, by factoring the area of the rectangle. Complete her work and state the length.

Area = lw
$A = x^2+4x-12$
$A = (\quad)(x-2)$
$A = (x+6)(x-2)$

$\frac{x^2+4x-12}{x-2} = l$

$\frac{x^2-4x-12}{-2x} =$

$x+2+6$

The length is
$(x+8)$

b. Kelly compares the length of the rectangle to the side of the square. State the difference in length of the rectangle to the side of the square.

c. Kelly is told that the areas of the two labels have to be equal. She correctly determines that this will occur when $x = 3$. Explain why her reasoning is correct, and demonstrate that the areas would be different for other values of x.

$x = 3$
$x^2 = 3^2 = 9$
$x^2+4x-12 = 3^2+4(3)-12 =$
$9+12-12 = 9$

$x = 4$
$x^2 = 4^2 = 16$
$x^2+4x-12 = 4^2+4(4)-12 =$
$16+16-12 = 20.$

Commentary

The student's

- response illustrates a significant start to the problem in that the calculations of Part C are correct (supportive reasoning and explanations are missing), and Part A is attempted but not carried out successfully
- response for Part C demonstrates an understanding of evaluating expressions
- communication provides limited information in that adequate explanations and reasoning are missing

Performance Assessment

- ***Task 1: Toothpick Triangle Patterns***
- ***Task 2: Volleyball Follies***
- ***Task 3: The Big Swallow***

Scoring Criteria for Performance Assessment Tasks 1, 2, and 3

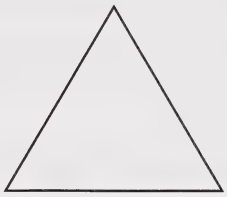
Mark	Scoring Criteria
6	*The student* • provides a correct and complete solution • demonstrates an understanding of the concepts and procedures related to the task • provides communication that is clear, understandable, and logically organized
5	*The student* • provides a correct and complete solution, with a few minor errors • demonstrates a clear understanding of all the major concepts and procedures • provides communication that is clear, understandable, and logically organized, although minor flaws may exist
4	*The student* • provides a complete solution, but some concepts or ideas may be missing or misrepresented, and a few minor errors may be present • demonstrates a correct understanding of the majority of major concepts and procedures • provides communication that is understandable and logically organized, but may contain a flaw or lack some clarity
3	*The student* • provides a complete response that demonstrates a correct major step in the solution of the problem • demonstrates some correct support or understanding of the major step • communicates understandable reasons for solutions
2	*The student* • provides a partial solution that is complete and correct • demonstrates some support and/or understanding for the partial solution • provides communication that is consistent with the task
1	*The student* • makes a significant start that could have led to the successful conclusion of a major step • provides a correct answer with no supporting work **or** provides a statement or procedure that shows some understanding of the process or steps involved • provides communication that is inadequate to the task
0	*The student* • presents work that is off topic • presents a blank paper

Note: Minor error means
- calculation error
- communication error
- missing or incorrect units, where applicable
- reasoning/logic error

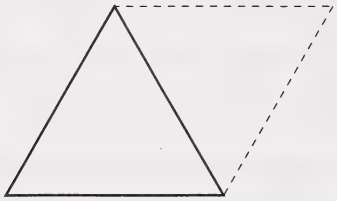
Task 1: Toothpick Triangle Patterns

Student Task and Solution

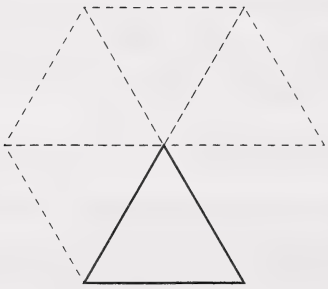
An equilateral triangle can be formed using 3 toothpicks.



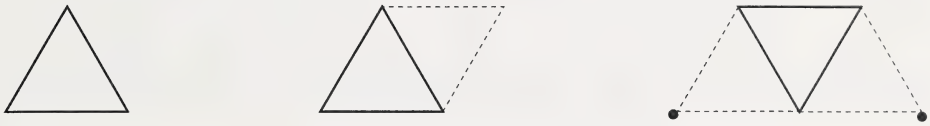
One triangle, which requires 3 toothpicks to build, is shown below. Additional equilateral triangles can be formed by adding more toothpicks to the original triangle, as shown.



Note: Do not form a pattern of triangles that represents a closed figure (with interim angles less than 180°), such as shown below.

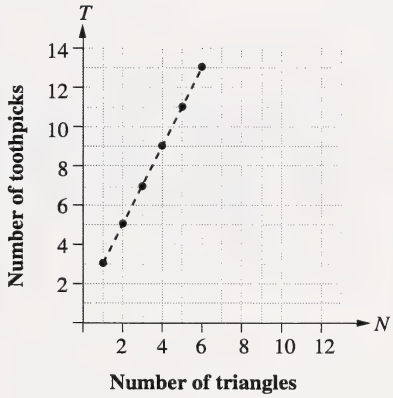


A. Using your toothpicks, continue this construction to complete the chart below.



Number of congruent equilateral Triangles	1	2	3	4	5	6
Number of Toothpicks Required	***3***	***5***	***7***	***9***	***11***	***13***

B. i. Represent the information contained in your table in graph form, using the grid below.



ii. Explain why a mathematician who was given this problem said that "the graph of this relation should not be a solid line, but, rather, specific points."

There should only be points, since only whole toothpicks are used and whole triangles are formed.

C. From either the table or the graph, determine the slope and y-intercept of this linear relation.

The slope is 2. The y-intercept is (0,1).

D. i. Find the equation that represents this linear relation, and use it to determine the number of toothpicks required to make 10 triangles.

The equation of the linear relation is $y = 2x + 1$. To make 10 triangles requires 21 toothpicks.

ii. Following this linear relation, how many triangles could you make from a box of 500 toothpicks? How many toothpicks would be left over?

Using this linear relation, 249 triangles can be formed, with 1 toothpick left over.

Student Responses for Performance Assessment 1 begin on page 26.

Student Examples

This response would receive a score of ***6***

Scoring Criteria

The student

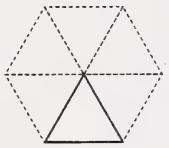
- provides a correct and complete solution
- demonstrates an understanding of the concepts and procedures related to the task
- provides communication that is clear, understandable, and logically organized

Task 1: Toothpick Triangle Patterns

An equilateral triangle can be formed, using 3 toothpicks.

One triangle is shown below, which requires 3 toothpicks to build. Additional equilateral triangles can be formed by adding more toothpicks to the original triangle, as shown.

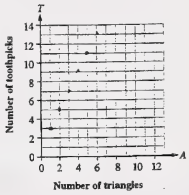
Note: Do not form a pattern of triangles that form a closed circle as shown below.



A. Using your toothpicks, continue this construction to complete the chart below.

Number of Triangles	1	2	3	4	5	6
Number of Toothpicks Required	3	5	7	9	11	13

B. i. Represent the information contained in your table in graph form, using the grid below.



ii. Explain why a mathematician, who was given this problem, said that "the graph of this relation should not be a solid line, but, rather, specific points."

Because there are no inbetween numbers
ex you can't use 1½ toothpick to make a triangle
it isn't part of the graph the graph only
has whole triangles not half triangles or
half toothpick.

Continued

Note: Student examples represent the pilot test form for the task.

Continued

C. From either the table or the graph, determine the slope and y-intercept of this linear relation.

Slope = $\frac{\text{Rise}}{\text{Run}} = \frac{\text{Diff of } y\text{'s}}{\text{Diff of } x\text{'s}}$

(1, 3), (2, 5)

$= \frac{5-3}{2-1}$

$= \frac{2}{1}$

y-intercept = (0, 1)

D. i. Find the equation that represents this linear relation, and use it to determine the number of toothpicks required to make 10 triangles.

$y = mx + b$

$5 = 2(2) + b$ → $y = 2x + 1$

$5 = 4 + b$

$1 = b$

x	y
10	21

It would take 21 toothpicks to make ten triangles.

ii. Following this pattern, how many triangles could you make from a box of 500 toothpicks? How many toothpicks would be left over?

$y/2 - 1 = x$

x	y
249	500

you could make 249 triangles and have one toothpick left.

Commentary

The student's

- response is complete, correct, and clearly communicated (the slope is defined clearly in Part C and the equation to solve for "x" in Part D.ii is identified); calculations are correct, and statements are conclusive and well-supported

This response would receive a score of **5**

Scoring Criteria

The student

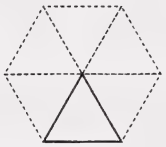
- provides a correct and complete solution, with a few minor errors
- demonstrates a clear understanding of all the major concepts and procedures
- provides communication that is clear, understandable, and logically organized, although minor flaws may exist

Task 1: Toothpick Triangle Patterns

An equilateral triangle can be formed, using 3 toothpicks.

One triangle is shown below, which requires 3 toothpicks to build. Additional equilateral triangles can be formed by adding more toothpicks to the original triangle, as shown.

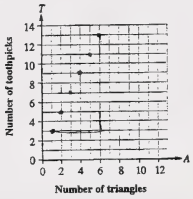
Note: Do not form a pattern of triangles that form a closed circle as shown below.



A. Using your toothpicks, continue this construction to complete the chart below.

Number of Triangles	1	2	3	4	5	6
Number of Toothpicks Required	3	5	7	9	11	13

B. i. Represent the information contained in your table in graph form, using the grid below.



ii. Explain why a mathematician, who was given this problem, said that "the graph of this relation should not be a solid line, but, rather, specific points."

Hi because there are defrate points, and there is no continuation between the points. you would use a solid line if you were showing something over a period of time like a persons height during the year

Continued

Note: Student examples represent the pilot test form for the task.

Continued

C. From either the table or the graph, determine the slope and y-intercept of this linear relation.

$m = \frac{rise}{run}$

$= \frac{10}{5}$

$= \frac{2}{1}$

y-intercept = 10

$Y = 2x + 1$

D. i. Find the equation that represents this linear relation, and use it to determine the number of toothpicks required to make 10 triangles.

$Y = 2x + 1$

x	y
1	3
2	5
3	7
4	9
5	11
6	13
7	15
8	17
9	19
10	21

you would need 21 toothpicks to make 10 triangles

ii. Following this pattern, how many triangles could you make from a box of 500 toothpicks? How many toothpicks would be left over?

$Y = 2x + 1$

$2x + 1 = 500$

$\frac{2x}{2} = \frac{499}{2}$

$x = 249.5$

$Y = 249.5x + 1$

you would be able to make 249 triangles and have 1 toothpick left over.

Commentary

The student's

- response is complete in providing all parts of the task, however; in Part B, the student does not mention toothpicks or triangles
- processes and calculations are evidence of reasoning that demonstrates correct understanding of the relationship between the table of values, equations, and graphs of linear functions
- communication is for the most part effective, clear, and logical

This response would receive a score of ***4***

Scoring Criteria

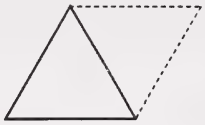
The student

- provides a complete solution but some concepts or ideas may be missing or misrepresented, and a few minor errors may be present
- demonstrates a correct understanding of the majority of major concepts and procedures
- provides communication that is understandable and logically organized, but may contain a flaw or lack some clarity

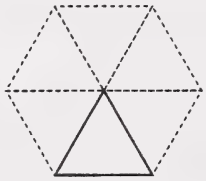
Task 1: Toothpick Triangle Patterns

An equilateral triangle can be formed, using 3 toothpicks.

One triangle is shown below, which requires 3 toothpicks to build. Additional equilateral triangles can be formed by adding more toothpicks to the original triangle, as shown.



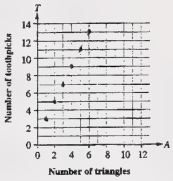
Note: Do not form a pattern of triangles that form a closed circle as shown below.



A. Using your toothpicks, continue this construction to complete the chart below.

Number of Triangles	1	2	3	4	5	6
Number of Toothpicks Required	3	5	7	9	11	13

B. i. Represent the information contained in your table in graph form, using the grid below.



ii. Explain why a mathematician, who was given this problem, said that "the graph of this relation should not be a solid line, but, rather, specific points."

Because you can not use half a toothpick to make a triangle.

C. From either the table or the graph, determine the slope and y-intercept of this linear relation. (1,3)(5,11)

$y = mx + b$

$m: \frac{\text{rise}}{\text{run}}$

$m: \frac{3-11}{1-5}$

$m: \frac{-8}{-4}$

$m: 2$

The slope is 2

The y-intercept would be (0,0)

D. i. Find the equation that represents this linear relation, and use it to determine the number of toothpicks required to make 10 triangles.

Number of toothpicks	3	5	7	9	11	13	15	17	19	21
Number of Δ	1	2	3	4	5	6	7	8	9	10

It requires 21 toothpicks to make 10 triangles

$y = mx + b$

$y = 2x + b$

$y = 2x$

$\frac{10}{2} = \frac{2}{2}$

$5 = x$

ii. Following this pattern, how many triangles could you make from a box of 500 toothpicks? How many toothpicks would be left over?

# of toothpicks	21	41	61	201	401	601	801	500
# of Δ	10	20	30	100	200	300	400	250

$y = mx + b$

$y = 2x + b$

$y = 2x$

$\frac{500}{2} = \frac{2x}{2}$

$250 = x$

Continued

Note: Student examples represent the pilot test form for the task.

Continued

Commentary
The student's • response is complete, but the y-intercept is wrong as presented in Part C, and this error is carried through to Part D; as well, the explanation in Part B.ii is only partly correct • work illustrates a correct understanding of major concepts and procedures related to equations, tables, and graphs of a linear function • communication is understandable for Part D.ii, and by providing justification in Part B.ii, it would have enhanced the communication component

This response would receive a score of **3**

Scoring Criteria

The student

- provides a complete response that demonstrates a correct major step in the solution to the problem
- demonstrates some correct support or understanding of the major step
- communicates understandable reasons for solutions

Task 1: Toothpick Triangle Patterns

An equilateral triangle can be formed, using 3 toothpicks.

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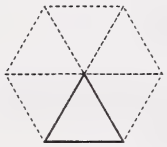
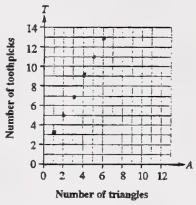
Note: Do not form a pattern of triangles that form a closed circle as shown below.



A. Using your toothpicks, continue this construction to complete the chart below.

Number of Triangles	1	2	3	4	5	6
Number of Toothpicks Required	3	5	7	9	11	13

B. i. Represent the information contained in your table in graph form, using the grid below.



ii. Explain why a mathematician, who was given this problem, said that "the graph of this relation should not be a solid line, but, rather, specific points."

The mathematician said that "the graph of this relation should not be a solid line, but, rather, specific points because if a solid line was used it would include everything between the points. Just by using the points shows that only those specific numbers are the ones being represented

Continued

Note: Student examples represent the pilot test form for the task.

Continued

C. From either the table or the graph, determine the slope and y-intercept of this linear relation.

Slope = $\frac{\text{rise}}{\text{run}}$

$m = \frac{(13-5)}{(6-3)}$

$m = 8/3$

$y = mx + b$

$y = 8/3x + 2.$

D. i. Find the equation that represents this linear relation, and use it to determine the number of toothpicks required to make 10 triangles.

$y = mx + b$

$10 = 8/3x + 2$

$80 = 8x + 16$

$64 = 8x$

$21 = x$

ii. Following this pattern, how many triangles could you make from a box of 500 toothpicks? How many toothpicks would be left over?

$y = mx + b$

$500 = 8/3x + 1$

you would use 499 toothpicks and 1 left over

Commentary

The student's

- response is complete and contains a major step in the solution to the task; however, the assessment in Parts A, B.i, and D were not answered correctly, the slope and y-intercept for Part C were not determined correctly, and the explanation for Part B.ii was not provided
- response demonstrates an understanding of the graphs, tables, and equations of linear functions, but only a partial understanding of slope and y-intercept derivation
- communication is understandable, but would have been enhanced if the answer in Part D.ii had been supported with the correct algebra and the final statements for Parts C and D.i were not missing

This response would receive a score of **2**

Scoring Criteria

The student

- provides a partial solution that is complete and correct
- demonstrates some support and/or understanding for the partial solution
- provides communication that is consistent with the task

Task 1: Toothpick Triangle Patterns

An equilateral triangle can be formed, using 3 toothpicks

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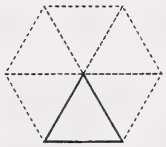
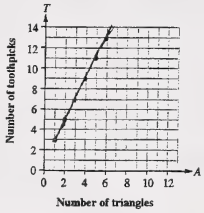
Note: Do not form a pattern of triangles that form a closed circle as shown below.



A. Using your toothpicks, continue this construction to complete the chart below.

Number of Triangles	1	2	3	4	5	6
Number of Toothpicks Required	3	5	7	9	11	13

B. i. Represent the information contained in your table in graph form, using the grid below.



ii. Explain why a mathematician, who was given this problem, said that "the graph of this relation should not be a solid line, but, rather, specific points."

Because you can form Triangles with edges of other Triangles

C. From either the table or the graph, determine the slope and y-intercept of this linear relation.

$\frac{y^1-y^2}{x^1-x^2}$

$\frac{-1-2}{3-5}$

$\frac{-1}{-2}$ $\boxed{=\frac{1}{2}}$

D. i. Find the equation that represents this linear relation, and use it to determine the number of toothpicks required to make 10 triangles.

? $x = n \times 2 + 1$

ii. Following this pattern, how many triangles could you make from a box of 500 toothpicks? How many toothpicks would be left over?

1001

Continued

Commentary
The student's • response is a partial solution, in that the chart and graph of Parts A and B.i are correct and the slope formula in Part C is correctly presented; the response would have been enhanced had the reasoning in Part B.ii not been fragmented and had Parts C and D been attempted correctly and completely • response demonstrates some understanding of graphs and tables of linear functions, even though the slope and formula derivations are misrepresented • communication is sufficient to support the partial solution presented

This response would receive a score of ***1***

Scoring Criteria

The student

- makes a significant start that could have led to the successful conclusion of a major step
- provides a correct answer with no supporting work **or** provides a statement or procedure that shows some understanding of the process or steps involved
- provides communication that is inadequate to the task

Task 1: Toothpick Triangle Patterns

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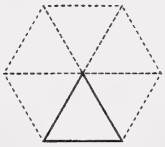
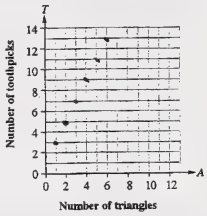


A. Using your toothpicks, continue this construction to complete the chart below.

Number of Triangles	1	2	3	4	5	6
Number of Toothpicks Required	3	5	7	9	11	13

B. i. Represent the information contained in your table in graph form, using the grid below.



ii. Explain why a mathematician, who was given this problem, said that "the graph of this relation should not be a solid line, but, rather, specific points."

it should be dots because the points don't go up in order, it goes 3, 5, 7, etc

C. From either the table or the graph, determine the slope and y-intercept of this linear relation.

X	2	3	4	5
y	3	5	7	9

D. i. Find the equation that represents this linear relation, and use it to determine the number of toothpicks required to make 10 triangles.

15 toothpicks

ii. Following this pattern, how many triangles could you make from a box of 500 toothpicks? How many toothpicks would be left over?

Continued

Note: Student examples represent the pilot test form for the task.

Continued

Commentary
The student's • response illustrates a significant start to the task, in that the chart and graph are complete and correct for Parts A and B.i • response demonstrates some understanding of graphs and tables of linear functions • communication is limited to the information provided and the explanation in Part B.ii could have been presented more clearly and correctly; as well, extraneous information is provided in Part C and a wrong answer is provided in Part D

Task 2: Volleyball Follies

Student Task and Solution

As team manager for your school's volleyball team, you are scouting opposing teams and collecting statistics on their players. You decide to compare heights of the players of two other teams. The heights (in cm) of the players for these teams are given in the tables below.

Springboks Player Heights (cm)
160
160
160
160
160
185
185
190
200
200

Antelopes Player Heights (cm)
160
160
160
165
180
185
185
185
190
190

A. Organize this data in a back-to-back stem-and-leaf plot, that has been started below.

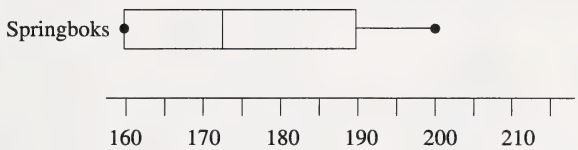
Springboks		Antelopes
0 0 0 0 0	16	*0 0 0 5*
	17	
5 5	18	*0 5 5 5*
0	19	*0 0*
0 0	20	

B. Calculate the mean, median, mode, and range of both sets of data.

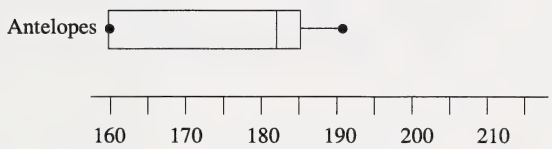
	Springboks		Antelopes
mean	***176 cm***	mean	***176 cm***
median	***172.5 cm***	median	***182.5 cm***
mode	***160 cm***	mode	***160 cm, 185 cm***
range	***40 cm***	range	***30 cm***

C. Organize the two sets of data into a 50% box-and-whisker plot below.

Springboks



Antelopes



D. As manager, you are to report your scouting results to the coach. Based on your analysis, which of the two teams has the height advantage? Support your conclusion in paragraph form, using all calculated measures of central tendency and dispersion.

While the average player height is the same in both cases, the median height of the Antelopes is higher than the Springboks. While the Springboks may have the tallest player (200 cm), 50% of the Antelopes are 182.5 cm or taller compared with 50% of the Springboks who are 172.5 cm or taller. The Antelopes have more players of the same height that are taller (modes of 160 and 185 compared with the mode of 160 for the Springboks).

Finally, the wider range of heights of the Springboks reflects the greater variation in their heights.

Overall, the Antelopes have a height advantage as the team median and mode are greater than the median and mode of the Springboks.

Student Examples

This response would receive a score of ***6***

Scoring Criteria

The student

- provides a correct and complete solution
- demonstrates an understanding of the concepts and procedures related to the task
- provides communication that is clear, understandable, and logically organized

Task 2: Volleyball Follies

As team manager for your school's volleyball team, you are scouting opposing teams and collecting statistics on their play. You decide to compare heights of the players of two other teams. The heights (in cm) of the players for these teams are given in the tables below.

Springboks	Antelopes
160 cm	160 cm
160 cm	160 cm
160 cm	160 cm
160 cm	165 cm
160 cm	180 cm
185 cm	185 cm
185 cm	185 cm
190 cm	185 cm
200 cm	190 cm
200 cm	190 cm

A. Organize this data in a back-to-back stem-and-leaf plot, which has been started below.

Springboks		Antelopes
0 0 0 0 0	16	0 0 0 5
	17	
5 5	18	0 5 5 5 5
0	19	0 0
0 0	20	

Note: The height of the first Springbok and the first Antelope have already been entered.

B. Calculate the mean, median, mode, and range of both sets of data.

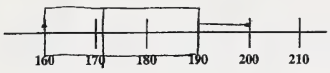
Springboks	Antelopes
Mean = 176	Mean = 176
$10\overline{)1760}$ = 176	$10\overline{)1760}$ = 176
Median = 172.5	Median = 182.5
160, 160, 160, 160, 160, 185, 185, 190, 200, 200	160, 160, 160, 165, 180, 185, 185, 185, 185, 190, 190
Mode = 160	Mode = 160 and 185
Range = 40	Range = 30
200 − 160 = 40	190 − 160 = 30

Continued

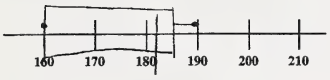
Continued

C. Organize the two sets of data into a box-and-whisker plot below.

Springboks 160, 160, 160, 160, 160, | 185, 185, 190, 200, 200



Antelopes 160, 160, 160, 165, 180 | 185, 185, 185, 190, 190



D. As manager, you are to report your scouting results to the coach. Based on your analysis, which of the two teams has the height advantage? Support your conclusion in paragraph form, using all calculated measures of central tendency and dispersion.

The Antalopes have the hieght advantage. Eventhough the average or mean of the two teams are the same, the median and mode is much higher on the Antalope's team Also, when a boxplot is drawn for both teams, the one belonging to the antelopes has a tendency to slant to the higher numbers while the Springbok's has a tendency to lean towards the lower numbers. In conclusion, the Anotalopes have the height advantage.

Commentary

The student's

- response is clear, complete, and accurate; answers and box plots are correct and the interpretations in Part D are insightful and effectively communicated, as in, for example, the explanation of the significance of the shapes of the box plots

This response would receive a score of **5**

Scoring Criteria

The student

- provides a correct and complete solution, with a few minor errors
- demonstrates a clear understanding of all the major concepts and procedures
- provides communication that is clear, understandable, and logically organized, although minor flaws may exist

Task 2: Volleyball Follies

As team manager for your school's volleyball team, you are scouting opposing teams and collecting statistics on their play. You decide to compare heights of the players of two other teams. The heights (in cm) of the players for these teams are given in the tables below.

Springboks	Antelopes
160 cm	160 cm
160 cm	160 cm
160 cm	160 cm
160 cm	165 cm
160 cm	180 cm
185 cm	185 cm
185 cm	185 cm
190 cm	185 cm
200 cm	190 cm
200 cm	190 cm

A. Organize this data in a back-to-back stem-and-leaf plot, which has been started below.

Springboks		Antelopes
00000	16	0005
	17	
55	18	0555
0	19	00
00	20	

Note: The height of the first Springbok and the first Antelope have already been entered.

B. Calculate the mean, median, mode, and range of both sets of data.

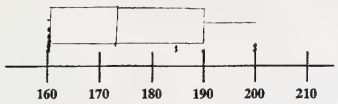
Springboks	Antelopes
Mean 176cm	Mean 176 cm
Median 172.5 cm	Median 182.5 cm
Mode 160 cm	Mode 185, 160
Range 40 cm	Range 30cm

Continued

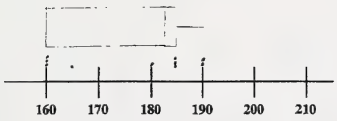
Continued

C. Organize the two sets of data into a box-and-whisker plot below.

Springboks



Antelopes



D. As manager, you are to report your scouting results to the coach. Based on your analysis, which of the two teams has the height advantage? Support your conclusion in paragraph form, using all calculated measures of central tendency and dispersion.

Based on my analysis, the Antelopes have the height advantage. Both of the teams shortest players are 160cm. The tallest players are on the Springboks team at 200cm, and the tallest players on the Antelopes are 190cm. However, **half** of the players on the Antelopes team are above 182.5cm tall, whereas half of the players on the Springboks team are above 172.5cm, a full 10cm smaller.

Commentary

The student's

- response is complete and correct for all parts of the task, except for Part B, where supporting calculations are missing
- response illustrates a correct understanding of the concepts and procedures related to statistics
- communication is effective and understandable, and would have been improved with supportive mathematical language (i.e., median and mode), which is missing from Part D

This response would receive a score of **4**

Scoring Criteria

The student

- provides a complete solution, but some concepts or ideas may be missing or misrepresented and a few minor errors may be present
- demonstrates a correct understanding of the majority of major concepts and procedures
- provides communication that is understandable and logically organized, but may contain a flaw or lack some clarity

Task 2: Volleyball Follies

As team manager for your school's volleyball team, you are scouting opposing teams and collecting statistics on their play. You decide to compare heights of the players of two other teams. The heights (in cm) of the players for these teams are given in the tables below.

Springboks	Antelopes
160 cm	160 cm
160 cm	160 cm
160 cm	160 cm
160 cm	165 cm
160 cm	180 cm
185 cm	185 cm
185 cm	185 cm
190 cm	185 cm
200 cm	190 cm
200 cm	190 cm

A. Organize this data in a back-to-back stem-and-leaf plot, which has been started below.

Springboks		Antelopes
0,0,0,0,0	16	0,0,0,5
	17	
5,5	18	0,5,5,5
0	19	0,0
0,0	20	

Note: The height of the first Springbok and the first Antelope have already been entered.

B. Calculate the mean, median, mode, and range of both sets of data.

Springboks

Mean

160×5 + 185 + 185 + 190 + 200 + 200 = 1760

1760 ÷ 10 = 176

176 cm

Median

185 + 160 = 345

345 ÷ 2 = 172.5

172.5 cm

Mode

160cm

Range

160cm – 200cm

Antelopes

Mean

160 + 160 + 160 + 165 + 180 + 185 + 185 + 185 + 190 + 190 = 1760

1760 ÷ 10 = 176

176cm

Median

180 + 185 = 365

365 ÷ 2 = 182.5

182.5cm

Mode

160cm, 185cm

Range

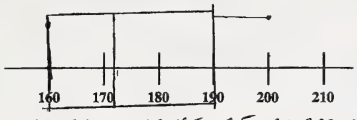
160cm – 190cm

Continued

Continued

C. Organize the two sets of data into a box-and-whisker plot below.

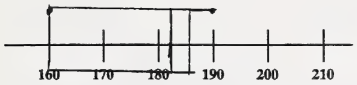
Springboks



160, 160, 160, 160, 160, 185, 185, 190, 200, 200

172.5cm

Antelopes



160, 160, 160, 165, 180, 185, 185, 185, 190, 190

D. As manager, you are to report your scouting results to the coach. Based on your analysis, which of the two teams has the height advantage? Support your conclusion in paragraph form, using all calculated measures of central tendency and dispersion.

From the data collected, the Antelopes have the height advantage. This is conclusive by the mean, median, mode and Range.

Even though the means are both at 176cm. The median and mode are higher than the Springboks by about 10-20cm. The range is more grouped together and the average height is a better speculation to use when calculating the height advantage.

Commentary

The student's

- response is complete, but the range is not calculated in Part B and the explanation in Part D is not presented correctly in that a supporting argument is contradicted by the incorrect statement, that the mean is better for calculating the height advantage
- work illustrates a correct understanding of the major concepts and procedures in statistics, but the concept of "average" in Part D is misrepresented
- communication is understandable for most parts, but clarity could have been improved in Part D by supporting reasoning with numbers and correct terminology

This response would receive a score of **3**

Scoring Criteria

The student

- provides a complete response that demonstrates a correct major step in the solution to the problem
- demonstrates some correct support or understanding of the major step
- communicates understandable reasons for solutions

Task 2: Volleyball Follies

As team manager for your school's volleyball team, you are scouting opposing teams and collecting statistics on their play. You decide to compare heights of the players of two other teams. The heights (in cm) of the players for these teams are given in the tables below.

Springboks	Antelopes
160 cm	160 cm
160 cm	160 cm
160 cm	160 cm
160 cm	165 cm
160 cm	180 cm
185 cm	185 cm
185 cm	185 cm
190 cm	185 cm
200 cm	190 cm
200 cm	190 cm

480
555
× 725

A. Organize this data in a back-to-back stem-and-leaf plot, which has been started below.

Springboks		Antelopes
00000	16	00055
	17	
55	18	0555
0	19	00
0 0	20	

Note: The height of the first Springbok and the first Antelope have already been entered.

B. Calculate the mean, median, mode, and range of both sets of data.

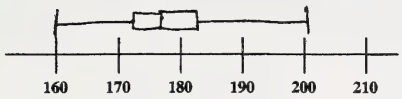
Springboks	Antelopes
Mean	Mean
176cm	176cm
Median	Median
172.5cm	182.5cm
Mode	Mode
160cm	160cm, 185cm
Range	Range
160cm - 200cm	160cm - 190cm
40cm	30cm

Continued

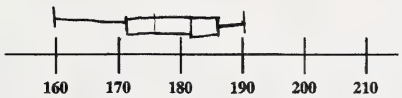
Continued

C. Organize the two sets of data into a box-and-whisker plot below.

Springboks



Antelopes



D. As manager, you are to report your scouting results to the coach. Based on your analysis, which of the two teams has the height advantage? Support your conclusion in paragraph form, using all calculated measures of central tendency and dispersion.

I would say the antelope have the height advantage. ~~So~~ To support this I would point out the range. This would conclude it because although the springboks have the tallest players, they are also the shortest players. The antelope have a better percentage of taller players and fewer shorter players.

Commentary

The student's

- response is complete and contains a major step in the solution to the task. Parts A, B, and D are answered correctly
- response would have been improved if Part B had supporting detail, Part C was correct, and the conclusion in Part D had some support
- response demonstrates an understanding of the concepts and procedures for determining statistical measures and a more complete understanding of box plots
- communication is understandable for the major parts, but ideas are misrepresented and unclear in Part D

This response would receive a score of **2**

Scoring Criteria

The student

- provides a partial solution that is complete and correct
- demonstrates some support and/or understanding for the partial solution
- provides communication that is consistent with the task

Task 2: Volleyball Follies

As team manager for your school's volleyball team, you are scouting opposing teams and collecting statistics on their play. You decide to compare heights of the players of two other teams. The heights (in cm) of the players for these teams are given in the tables below.

Springboks	Antelopes
160 cm	160 cm
160 cm	160 cm
160 cm	160 cm
160 cm	165 cm
160 cm	180 cm
185 cm	185 cm
185 cm	185 cm
190 cm	185 cm
200 cm	190 cm
200 cm	190 cm

A. Organize this data in a back-to-back stem-and-leaf plot, which has been started below.

Springboks		Antelopes
16000	16	0005
	17	
551	18	0555
0	19	00
00	20	

Note: The height of the first Springbok and the first Antelope have already been entered.

B. Calculate the mean, median, mode, and range of both sets of data.

Springboks

Mean 1760 ÷ 10

= 176

Median

185 − 160 = 25 ÷ 2

= 12.5

160.0
+ 12.5
172.5

= 172.5

Mode

= 160

Range

= 40

Antelopes

Mean 1760 ÷ 10

= 176

Median 185 − 180 = 5 ÷ 2 = 2.5

180
+ 2.5
182.5 = 182.5

Mode

= 185

Range

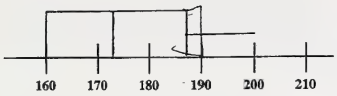
= 30

Continued

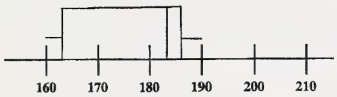
Continued

C. Organize the two sets of data into a box-and-whisker plot below.

Springboks



Antelopes



D. As manager, you are to report your scouting results to the coach. Based on your analysis, which of the two teams has the height advantage? Support your conclusion in paragraph form, using all calculated measures of central tendency and dispersion.

The team that has the height advantage is the Antelopes

The median of the antelopes is higher than the springboks so the antelopes have the height advantage

Commentary

The student's

- response is a partial solution in that Parts A and B are correct; however, the box plots are incorrect in Part C and incomplete support is provided to verify the answer in Part D
- response illustrates an understanding of the procedures related to calculating statistical measures and a partial understanding of procedures related to determining box plots
- communication provides enough information to support the partial solution

This response would receive a score of ***1***

Scoring Criteria

The student

- makes a significant start that could have led to the successful conclusion of a major step
- provides a correct answer with no supporting work **or** provides a statement or procedure that shows some understanding of the process or steps involved
- provides communication that is inadequate to the task

Task 2: Volleyball Follies

As team manager for your school's volleyball team, you are scouting opposing teams and collecting statistics on their play. You decide to compare heights of the players of two other teams. The heights (in cm) of the players for these teams are given in the tables below.

Springboks	Antelopes
160 cm	160 cm
160 cm	160 cm
160 cm	160 cm
160 cm	165 cm
160 cm	180 cm
185 cm	185 cm
185 cm	185 cm
190 cm	185 cm
200 cm	190 cm
200 cm	190 cm

A. Organize this data in a back-to-back stem-and-leaf plot, which has been started below.

Springboks		Antelopes
0 0 0 0 0	16	0 0 0 5
	17	
5 5	18	0 5 5 5
0	19	0, 0
0 0	20	

Note: The height of the first Springbok and the first Antelope have already been entered.

B. Calculate the mean, median, mode, and range of both sets of data.

Springboks

Mean

160
160
160
160
160
185
185
190
+ 200
200
1760

10) 1760 = 176

Mean = 176

Median

160, 160, 160, 160, 160
185, 185, 190, 200, 200
160 + 185
167.5
Median = 167.5

Mode

160 160 160 160 160
185 185 190 200
Mode is 160

Range

Antelopes

Mean

160
160
160
165
180
185
185
185
190
190
1760

10) 1760 = 176

mean = 176

Median

160 160, 160 165, 180, 185 185 185
190 190
180 + 185
median 182.5

Mode

160, 160, 160, 165, 180, 185, 185
185 190 190
Mode is 160 and 185
167.5

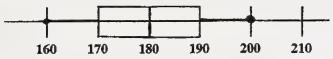
Range

Continued

Continued

C. Organize the two sets of data into a box-and-whisker plot below.

Springboks

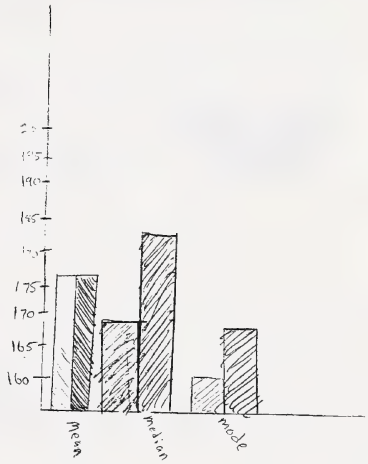


Antelopes

D. As manager, you are to report your scouting results to the coach. Based on your analysis, which of the two teams has the height advantage? Support your conclusion in paragraph form, using all calculated measures of central tendency and dispersion.

= Springboks
= Antelopes

Average volleyball player height



Commentary

The student's

- response illustrates a significant start to the task in Part A, and most of Part B is attempted and provides some successful conclusions
- response demonstrates some understanding of procedures and measures of statistics (i.e., mean and median); the integrity of the solution would have been enhanced if the data had not been misrepresented graphically, and if calculation and conceptual errors had not been made
- communication provides limited information, whereby the presentation of mean, median, and mode graphs in Part D are not connected to the question

Task 3: The Big Swallow

Student Task and Solution

You are the manager of a local convenience store. One of the items that you sell is a flavoured ice drink called "**The Big Swallow**."

The Big Swallow
80 cents
Regular Price

Your **cost** for the drink and cups is always 30¢ per serving.

The difference between your **cost** and your **selling price** is your **profit**.

A. You normally sell the Big Swallow for 80¢.

i. Calculate the profit you make per serving.

profit = 80¢ – 30¢ = 50¢ per serving

ii. Calculate your total profit if you sell 500 servings in one week.

500 × $0.50 = $250.00

B. To increase your profits, you decide to experiment with different types of discounts.

The Big Swallow
10% off
This Week Only

i. During one week, you decide to try a 10% discount off the regular price.

a. Calculate your new selling price and profit per serving.

Selling price = 80¢ – 8¢ = 72¢ per serving

Profit = 72¢ – 30¢ = 42¢ per serving

b. If you sold 620 servings in this week, what would the total amount of your profit be?

620 × $0.42 = $260.40

ii. During another week, you try a coupon special, where each drink costs 10¢ less with a coupon.

a. Calculate your new selling price and profit per serving.

Selling price = 80¢ – 10¢ = 70¢ per serving
Profit = 70¢ –30¢ = 40¢ per serving

b. If you sold 650 servings in this week, what would the total amount of your profit be? Show your calculations

650 × $0.40 = $260.00 profit

iii. For a third week, you try a reward system, where frequent customers get a fourth drink free if they purchase three at the regular price within the same week.

Under this plan, you sell 800 servings, that includes 200 free fourth drinks. How much profit do you make?

600 servings @ 50¢ profit = $300.00
200 servings @ 30¢ loss = ($60.00)

Total profit = $240.00

C. Which of the three plans was the best from the point of view of making a profit?

At the current sales levels, the most profit was derived from the 10% discount approach.

D. Which of the three plans was the best from the point of view of the purchasers

- if they bought a single serving in a week?

Single serving		
10% discount	*10¢ off*	*Frequent Swallower*
72¢	*70¢*	*80¢*

The 10¢ off is best.

- if they bought four servings in a week?

Four servings		
$2.88	*$2.80*	*$2.40*

The Frequent Swallower special is best.

E. If you wanted to continue with the Frequent Swallower plan, what is the minimum number of servings that you would have to sell in order to make $260 profit?

Explain and **use** a procedure to find this result.

A number of different approaches can be used to solve this, from ratio and proportion, to equations, to trial and error. At 868 (paid and free) servings, the vendor makes $260.40 profit.

Note: Answers of 866 and 867 are also acceptable because the profit is $260.20 and $260.70 respectively (assuming that the pattern of 3 each then one free is maintained).

Student Examples

This response would receive a score of ***6***

Scoring Criteria

The student

- provides a correct and complete solution
- demonstrates an understanding of the concepts and procedures related to the task
- provides communication that is clear, understandable, and logically organized

Task 3: The Big Swallow

You are the manager of a local convenience store. One of the items that you sell is a flavoured ice drink called "**The Big Swallow**."

The Big Swallow
80 cents
Regular Price

Your **cost** for the drink and cups is always 30¢ per serving.

The difference between your **cost** and your **selling price** is your **profit**.

A. You normally sell the Big Swallow for 80¢.

i. Calculate the profit you make per serving.

$$\begin{array}{r} 80 \\ -\ 30 \\ \hline 50 \end{array}$$

The profit is 50 cents.

ii. Calculate your total profit if you sell 500 cups in one week.

$$\begin{array}{r} 500 \\ \times\ 30 \\ \hline 15000 \end{array} \qquad \begin{array}{r} 500 \\ .80 \\ \hline 40000 \end{array} \qquad \begin{array}{r} 400 \\ -150 \\ \hline 250 \end{array}$$

The total profit would be \$250.00.

B. To increase your profits, you decide to experiment with different types of discounts.

The Big Swallow
10% off
This Week Only

i. During one week, you decide to try a 10% discount off the regular price.

a. Calculate your new selling price and profit per serving.

$$\begin{array}{r} .72 \\ .30 \\ \hline .42 \end{array} \qquad \frac{.80}{100} = \frac{x}{90} \qquad x = .72$$

new selling price = 72 cents
new profit = 42 cents

b. If you sold 620 servings in this week, calculate the total amount of profit.

$$\begin{array}{r} 620 \\ .42 \\ \hline 260.40 \end{array}$$

Total profit = \$260.40

Continued

Continued

ii. During another week, you try a coupon special, where each drink is 10¢ off with a coupon.

a. Calculate your new selling price and profit per serving.

selling price = 70 cents
profit = 40 cents

b. If you sold 650 servings in this week, calculate your total profit.

650
.40
260

profit = $260.00

iii. For a third week, you try a reward system, where frequent customers get a fourth drink free if they purchase three at the regular price within the same week.

Under this plan, you sell 800 servings, which included 200 free fourth drinks. How much profit did you make?

800
×.80
$640

200
×.80
$160

640
160
$480

800
.30
240

480
240
$240

profit = $240.00

C. Which of the three plans was the best from the point of view of making a profit?

The 10% off was the best one. (first one)

D. Which of the three plans was better from the point of view of purchasers

- if they bought a single serving in a week?

The 10¢ off coupon (second one)

- if they bought four servings in a week?

Frequent swallower special (third one)

E. If you wanted to continue with the Frequent Swallower plan, what is the minimum number that you would have to sell in order to make $260 profit?

Explain and **use** a procedure to find this result.

$\frac{800}{240} = \frac{x}{260}$

$x = 866$

you would have to sell 866 servings.

Commentary

The student's

- response is complete, accurate, and effectively communicated in a well-organized manner
- response is insightful for some parts of the solution (i.e., using ratio from Part B.iii to determine the answer in Part E)

This response would receive a score of **5**

Scoring Criteria

The student

- provides a correct and complete solution, with a few minor errors
- demonstrates a clear understanding of all the major concepts and procedures
- provides communication that is clear, understandable, and logically organized, although minor flaws may exist

Task 3: The Big Swallow

You are the manager of a local convenience store. One of the items that you sell is a flavoured ice drink called "**The Big Swallow**."

The Big Swallow
80 cents
Regular Price

Your **cost** for the drink and cups is always 30¢ per serving.

The difference between your **cost** and your **selling price** is your **profit**.

A. You normally sell the Big Swallow for 80¢.

i. Calculate the profit you make per serving.

50¢

ii. Calculate your total profit if you sell 500 cups in one week.

$250.00

B. To increase your profits, you decide to experiment with different types of discounts.

The Big Swallow
10% off
This Week Only

i. During one week, you decide to try a 10% discount off the regular price.

a. Calculate your new selling price and profit per serving.

Price - 72¢ Profit - 42¢

b. If you sold 620 servings in this week, calculate the total amount of profit.

$260.40

Continued

Continued

ii. During another week, you try a coupon special, where each drink is 10¢ off with a coupon.

a. Calculate your new selling price and profit per serving.

Price - 70¢ Profit - 40¢

b. If you sold 650 servings in this week, calculate your total profit.

$ 260.00

iii. For a third week, you try a reward system, where frequent customers get a fourth drink free if they purchase three at the regular price within the same week.

Under this plan, you sell 800 servings, which included 200 free fourth drinks. How much profit did you make?

$ 240.00

C. Which of the three plans was the best from the point of view of making a profit?

10% off

D. Which of the three plans was better from the point of view of purchasers

- if they bought a single serving in a week?

10¢ off

- if they bought four servings in a week?

buy 3 get 4th free

E. If you wanted to continue with the Frequent Swallower plan, what is the minimum number that you would have to sell in order to make $260 profit?

Explain and **use** a procedure to find this result.

216.7
4) 866.8
8
66
4
26
24
28
28
0

866.8
- 216.7
650.1

650.1
× .50
325.050

2 3
216.7
.30
65.010

2
305.05
- 65.01
$ 260.04

You have now completed the field test.
If you have time, you may wish to check your answers.

If they sold 866.8 servings they would make a profit of $260.04.

Commentary

The student's

- response is complete and accurate for all parts of the task, except for Part E. In Part E, the student forgets to round (i.e., it is not logical to sell 866.8 servings) and does not explain the significance of the various mathematical operations provided
- work illustrates a correct understanding of the major concepts and procedures related to number skills (ratios)
- Part E could be more clearly presented and supporting detail to the calculations should be included

This response would receive a score of ***4***

Scoring Criteria

The student

- provides a complete solution, but some concepts or ideas may be missing or misrepresented, and a few minor errors may be present
- demonstrates a correct understanding of the majority of major concepts and procedures
- provides communication that is understandable and logically organized, but may contain a flaw or lack some clarity

Task 3: The Big Swallow

You are the manager of a local convenience store. One of the items that you sell is a flavoured ice drink called "**The Big Swallow.**"

The Big Swallow
80 cents
Regular Price

Your **cost** for the drink and cups is always 30¢ per serving.

The difference between your **cost** and your **selling price** is your **profit**.

A. You normally sell the Big Swallow for 80¢.

i. Calculate the profit you make per serving.

.80 - .30 = .50
your profit is .50¢

ii. Calculate your total profit if you sell 500 cups in one week.

500 x .5 = $250
your total profit will be $250 in one week.

B. To increase your profits, you decide to experiment with different types of discounts.

The Big Swallow
10% off
This Week Only

i. During one week, you decide to try a 10% discount off the regular price.

a. Calculate your new selling price and profit per serving.

.8 x .1 = .08 .8 - .08 = .72

Your new selling price is 72 cents
.72 - .30 = .42

Your new profit per servings is 42 cents

b. If you sold 620 servings in this week, calculate the total amount of profit.

620 x .42 = 260.40

Your profit on 620 servings with 10% off the regular price would be 260.40

Continued

Continued

ii. During another week, you try a coupon special, where each drink is 10¢ off with a coupon.

a. Calculate your new selling price and profit per serving.

.80 - .10 = .70

Your new selling price is 70 cents

.70 - .30 = .40

Your new profit would be 40 cents

b. If you sold 650 servings in this week, calculate your total profit.

650 x .4 = 260

Your total profit this week would be $260.

iii. For a third week, you try a reward system, where frequent customers get a fourth drink free if they purchase three at the regular price within the same week.

Under this plan, you sell 800 servings, which included 200 free fourth drinks. How much profit did you make?

600 x .5 = 300

You would make a $300 profit.

C. Which of the three plans was the best from the point of view of making a profit?

The Frequent Swallow Special.

D. Which of the three plans was better from the point of view of purchasers

- if they bought a single serving in a week?

The Big Swallow 10¢ off Special

- if they bought four servings in a week?

Frequent Swallow Special

E. If you wanted to continue with the Frequent Swallower plan, what is the minimum number that you would have to sell in order to make $260 profit?

Explain and **use** a procedure to find this result.

$\frac{\text{Expected profit}}{\text{profit on Reg Price}}$ = # of Servings needed to get Expected profit

$\frac{260}{.5} = 520$

proof = 520 x .5 = 260

Commentary

The student's

- response is complete, but the answers in Parts B.iii. and E are incorrect
- response illustrates a correct understanding of most concepts related to number skills (ratios), but incomplete understanding is apparent in Parts B.iii. and E (i.e., not subtracting the costs of free drinks in Part B.iii.)
- communication is understandable for the most part

This response would receive a score of **3**

Scoring Criteria

The student

- provides a complete response that demonstrates a correct major step in the solution to the problem
- demonstrates some correct support or understanding of the major step
- communicates understandable reasons for solutions

Task 3: The Big Swallow

You are the manager of a local convenience store. One of the items that you sell is a flavoured ice drink called "**The Big Swallow**."

The Big Swallow
80 cents
Regular Price

Your **cost** for the drink and cups is always 30¢ per serving.

The difference between your **cost** and your **selling price** is your **profit**.

A. You normally sell the Big Swallow for 80¢.

i. Calculate the profit you make per serving.

= 80 - 30 = 50¢ profit

ii. Calculate your total profit if you sell 500 cups in one week.

500 ÷ 2 = ($250)

B. To increase your profits, you decide to experiment with different types of discounts.

The Big Swallow
10% off
This Week Only

i. During one week, you decide to try a 10% discount off the regular price.

a. Calculate your new selling price and profit per serving.

80 - 10¢ = 72 - 30 = 42¢ profit

b. If you sold 620 servings in this week, calculate the total amount of profit.

620 × .42 = $260.40

Continued

Continued

ii. During another week, you try a coupon special, where each drink is 10¢ off with a coupon.

a. Calculate your new selling price and profit per serving.

80 - 10 - 30 = 40¢ profit

b. If you sold 650 servings in this week, calculate your total profit.

650 x .40 = $260

iii. For a third week, you try a reward system, where frequent customers get a fourth drink free if they purchase three at the regular price within the same week.

Under this plan, you sell 800 servings, which included 200 free fourth drinks. How much profit did you make?

800 x .50 $400
200 x .30 ~~$60~~ 60
$340 profit

C. Which of the three plans was the best from the point of view of making a profit?

the Frequent Swallower Special

D. Which of the three plans was better from the point of view of purchasers

- if they bought a single serving in a week?

the 10 ¢ Coupon

- if they bought four servings in a week?

the Frequent swallower Special

E. If you wanted to continue with the Frequent Swallower plan, what is the minimum number that you would have to sell in order to make $260 profit?

Explain and **use** a procedure to find this result.

260 ÷ .50 = 520 sold
520 ÷ 4 = 130 fourth free ones

you would have to sell 520 drinks

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Commentary

The student's

- response is complete and contains a correct major step in the solution of the problem; Parts A, B.iii., and D are correctly answered, but Parts B.i., and B.ii., and E are not
- calculations and explanations demonstrate some understanding of number skills, although communication related to profit and selling price contain syntax errors in Part B.i. and logic errors in Part B.ii., and E
- communication is understandable for the most part but would have been improved with more detail

This response would receive a score of **2**

Scoring Criteria

The student

- provides a partial solution that is complete and correct
- demonstrates some support and/or understanding for the partial solution
- provides communication that is consistent with the task

Task 3: The Big Swallow

You are the manager of a local convenience store. One of the items that you sell is a flavoured ice drink called "**The Big Swallow**."

The Big Swallow
80 cents
Regular Price

Your **cost** for the drink and cups is always 30¢ per serving.

The difference between your **cost** and your **selling price** is your **profit**.

A. You normally sell the Big Swallow for 80¢.

i. Calculate the profit you make per serving.

80¢ − 30¢ = 50¢
you make 50¢ per serving.

ii. Calculate your total profit if you sell 500 cups in one week.

30¢ × 500 cups = $150.00 400 150
80¢ × 500 cups = $400.00
$400.00 − $150.00 = $250.00 dollar profit.

B. To increase your profits, you decide to experiment with different types of discounts.

The Big Swallow
10% off
This Week Only

i. During one week, you decide to try a 10% discount off the regular price.

a. Calculate your new selling price and profit per serving.

80¢ with a 10% discount = 72¢ per serving
30¢ with a 10% discount = 27¢ per serving
your profit is now 45¢ per serving

b. If you sold 620 servings in this week, calculate the total amount of profit.

72 × 620 = $446.40 per serving
27 × 620 = $167.40 per serving
in this week your profit would be $279.00 for this week.

Continued

Continued

ii. During another week, you try a coupon special, where each drink is 10¢ off with a coupon.

a. Calculate your new selling price and profit per serving.

new selling price = 70¢
new selling price = 20¢
profit = 50¢

b. If you sold 650 servings in this week, calculate your total profit.

650 × 50¢ = $325.00 dollars.

iii. For a third week, you try a reward system, where frequent customers get a fourth drink free if they purchase three at the regular price within the same week.

Under this plan, you sell 800 servings, which included 200 free fourth drinks. How much profit did you make?

800 - 200 = 600 × 80¢ = $480.00 dollars
600 × 0.30¢ = $180.00 dollars
your profit for this particular week would be $300.00 if they get the fourth one free.

C. Which of the three plans was the best from the point of view of making a profit?

The coupon would be the best profit made.

D. Which of the three plans was better from the point of view of purchasers

- if they bought a single serving in a week?

the coupon

- if they bought four servings in a week?

the coupon / coupon.

E. If you wanted to continue with the Frequent Swallower plan, what is the minimum number that you would have to sell in order to make $260 profit?

Explain and use a procedure to find this result.

416
150
260

525 × 0.80 = 420
525 × 0.30 = 157.50
profit = 262.50
you would have to ~~make sell~~ 525 servings to make $260.00 dollars profit.

520 × 0.80 = 416
520 × 0.30 = 156
profit $260.00

You have now completed the field test.
If you have time, you may wish to check your answers.

Commentary

The student's

- response is a partial solution in that Parts A and B.ii are correctly answered, and although all other parts are attempted, incorrect reasoning in Parts B.i, B.iii, and E affect the integrity of the solution (i.e., profit is confused with discount)
- supportive reasoning for the partial solution shows understanding of concepts related to number skills and profit
- communication is adequately provided for the partial solution

This response would receive a score of ***1***

Scoring Criteria

The student

- makes a significant start that could have led to the successful conclusion of a major step
- provides a correct answer with no supporting work **or** provides a statement or procedure that shows some understanding of the process or steps involved
- provides communication that is inadequate to the task

Task 3: The Big Swallow

You are the manager of a local convenience store. One of the items that you sell is a flavoured ice drink called "**The Big Swallow**."

The Big Swallow
80 cents
Regular Price

Your **cost** for the drink and cups is always 30¢ per serving.

The difference between your **cost** and your **selling price** is your **profit**.

A. You normally sell the Big Swallow for 80¢.

i. Calculate the profit you make per serving.

80¢ − 30¢ = youre profit

80¢ − 30¢ = 50¢ is your profit on the big Swallow.

ii. Calculate your total profit if you sell 500 cups in one week.

500 cups × 80¢/per cup = How much money made. = $40,000

$40,000 ÷ 50¢ profit/cup = $800

B. To increase your profits, you decide to experiment with different types of discounts.

The Big Swallow
10% off
This Week Only

i. During one week, you decide to try a 10% discount off the regular price.

a. Calculate your new selling price and profit per serving.

80¢ − 10% = Hit youre % key gives you the new selling price.

= 70¢/100 = 70¢ − 30¢

= 40¢ youre profit

b. If you sold 620 servings in this week, calculate the total amount of profit.

620 servings × 70¢/per cup = How much money made

= 43,400

$43,000 ÷ 40¢ profit/cup = $1,075 is youre profit

Continued

Continued

ii. During another week, you try a coupon special, where each drink is 10¢ off with a coupon.

a. Calculate your new selling price and profit per serving.

70¢ is selling price
70¢ - 30 = Profit = 40¢/cup = profit

b. If you sold 650 servings in this week, calculate your total profit.

650 x 70¢ = 45500 ÷ 40¢ = $11,37.5 total profit

iii. For a third week, you try a reward system, where frequent customers get a fourth drink free if they purchase three at the regular price within the same week.

Under this plan, you sell 800 servings, which included 200 free fourth drinks. How much profit did you make?

$ 800 - 200 = total serves
= 500 x 70¢/cup
= 35000 ÷ 40¢/cup
= $875 is your profit you made.

C. Which of the three plans was the best from the point of view of making a profit?

the big swallow 10¢ coupon off this week was the best for a profit wise.

D. Which of the three plans was better from the point of view of purchasers

- if they bought a single serving in a week? the big swallow 10¢ coupon this week only if had coupon if not it would be the (the outlaw 80¢/glass)
- if they bought four servings in a week? the big swallow frequent swallower special buy three in a week get fourth free

E. If you wanted to continue with the Frequent Swallower plan, what is the minimum number that you would have to sell in order to make $260 profit?

Explain and use a procedure to find this result.

50¢ - 10¢ = profit per/glass.
= 40
40¢ x 6.5 = $260

Commentary

The student's

- response illustrates a significant start to the task, in that some parts are correctly calculated
- response would have been more successful if reasoning/concept errors in Parts A.ii, B.i.b, B.ii.b, and E (such as converting cents to dollars) had not been made
- communication provides limited information and some information provided is extraneous or unclear (i.e., in Part A, money made is divided by fifty cents profit per cup)

Project

• *Statistical Inquiry*

CLASSROOM
ASSESSMENT
MATERIALS

Project: Statistical Inquiry

Student Task

Problem

As a statistical analyst, you are required to:

a. design a statistical experiment that would generate **numerical data**
b. collect **numerical data** and make visual presentations of your findings
c. analyze your data
d. generalize and evaluate your statistical findings

For this project, you may collect your data individually or in groups of 2, 3, or 4, and complete your own written presentation within 5 periods (one week).

Resources

- Technologies to collect, calculate, and present data
- Data sources (publications, databases, Statistics Canada, surveys)
- Presentation instruments and materials (graph paper, poster board, photographs, tapes, etc.)

Project Guidelines

1. Design
(Periods 1 and 2)

- Identify a problem or question of interest whose answer is best determined through statistical experimentation and analysis of **numerical data**, and give reasons for your topic selection.
- Formulate a hypothesis or predict a general outcome of the investigation.
- Identify the population to be surveyed.
- Determine an appropriate method for selecting a representative sample.
- Evaluate the sampling method for bias:
  - Is the sample size adequate?
  - Is the survey question clear?
  - What errors are anticipated?

Note: Upon completion of the above tasks, fill out the "Statistics Project Approval Sheet," found at the back of the booklet, and have it checked and signed by your teacher.

Continued

Continued

2. Organization and Visual Presentation
(Periods 2 and 3)

- Conduct your survey and neatly record your results on tally sheets (to be kept).
- Construct a visual representation of your data:
  i. Organize and display your data, using two or more of the formats studied:
     – stem-and-leaf plot
     – 50% box-and-whisker plot
     – histograms or other appropriate displays
  ii. Provide reasoning for the organization and presentation of your project.

3. Analysis
(Periods 3 and 4)

- Analyze your data and visual presentations to determine the measures of central tendency and dispersion. The analysis should include:
  – mean, median, mode
  – range, lower and upper extremes, lower and upper quartiles, interquartile range, and outliers (whiskers)
- Draw and defend conclusions based upon the analysis of your data, including an inference about the general population.

4. Generalization and Evaluation
(Periods 4 and 5)

- Defend or reject your hypothesis, with generalizations based upon your data and analysis.
- Evaluate your project and its findings (i.e., errors, biases, difficulties, suitability, confidence, etc.).
- Extend your findings to other populations, and make further recommendations for future investigations that could supplement your analysis of this topic.

What to include in your written presentation

1. Introduction

- Responses made as you carried out the tasks under the guidelines of "Design."

2. Organization and Visual Presentation

- Data charts, graphs, and visual presentations should be organized together (except tally sheets, which should be included at the end of your project).
- Reasons for selection of display formats.

3. Analysis

- Calculations and insights made under the task guideline "Analysis."

4. Conclusion

- Statements developed under the task guideline "Generalization and Evaluation."

Note: References actually consulted and found to be useful should be cited within the main text where used; e.g., an equation, a definition, data, computer programs.

Project Scoring Criteria

The scoring criteria rate the student's project across several categories. Sets of descriptions for judging and scoring student work are included under each category. The scores from each category can then be added to obtain a total mark for the entire project and recorded on the project scoring sheet. The scoring criteria that follows includes the categories of Design, Organization and Visual Presentation, Analysis, Generalization and Evaluation, and Communication. The criteria for each category are shared with students in the student booklet and should be applied holistically when scoring the project.

To assist in the marking process of each student's project, a project scoring sheet follows. The marks allotted in each of the five categories shall be added for a possible total of 30 marks and recorded on the class record form that follows. As well, examples of student work, with applied criteria and commentary, are provided for assessing the project.

Category	Marks	Scoring Criteria
Design		*The student*
question, population, sample, hypothesis, method of collection	**6**	• clearly identifies the problem and provides all steps and information necessary for conducting the project
	5	• clearly identifies the problem and provides all steps and information necessary for conducting the project, with a minor error
	4	• substantially identifies the problem and provides most steps and/or information necessary for conducting the project
	3	• reasonably identifies the problem although some of the steps and information are flawed or missing
	2	• provides an unclear identification of the problem and the process; response may contain steps that are fragmented or missing
	1	• makes a significant start that shows some understanding of the process or of the information related to the problem
	0	• presents work that does not reflect any understanding of the statistical design process

Continued

Continued

Category	Marks	Scoring Criteria
Organization and Visual Presentation tally sheets, charts and/or graphs (at least two types)		*The student*
	6	• chooses correct formats to organize and represent data. The charts, diagrams or graphs are presented clearly, with supporting reasons for their choice
	5	• chooses correct formats to organize and represent data. All required charts, diagrams or graphs are presented, but there may be minor errors in presentation
	4	• chooses correct formats to organize and represent data. Most charts, diagrams, or graphs are presented clearly and correctly
	3	• chooses correct formats to organize and represent data. Some charts, diagrams, or graphs contain major errors or are missing
	2	• presents a few charts, diagrams, or graphs, some of which are flawed
	1	• makes a significant start in presenting charts, diagrams, or graphs related to the problem
	0	• attempts charts, diagrams, or graphs that are not relevant
Analysis calculations/analysis of measures of central tendency and dispersion		*The student*
	6	• analyzes and interprets correctly, thoroughly, and insightfully, using appropriate statistical procedures measures, and calculations
	5	• analyzes the data effectively, using appropriate statistical procedures and calculations, but the analysis may contain a few minor errors
	4	• analyzes and interprets major portions of the project and data reasonably, but small parts of the analysis are missing or flawed
	3	• makes a reasonable attempt to analyze the data but the analysis contains major errors or lacks significant parts
	2	• makes a significant attempt to analyze some part of the data
	1	• makes a weak attempt to start an analysis or calculation relevant to the analysis
	0	• shows no relevant attempt to analyze the data

Continued

Continued

Category	Marks	Scoring Criteria
Generalization and Evaluation conclusions, interpretations, and recommendations		*The student*
	6	• provides generalizations and interpretations that are insightful, complete, and correct
	5	• provides all required generalizations and interpretations, which are complete and correct
	4	• provides some required generalizations and interpretations which are complete and correct
	3	• provides some generalizations and interpretations that are weak but lead to a correct inference
	2	• attempts to make generalizations and interpretations that are appropriate but flawed
	1	• attempts to provide some generalization or interpretation
	0	• attempts no generalization or interpretation
Communication appeal, organization, extension, consistency, and communication		*The student*
	6	• provides detail, and communicates and presents the project effectively and clearly
	5	• provides detail, communicates and presents the project effectively, but the communication contains a minor flaw
	4	• communicates and presents the project well in general terms, but the communication lacks in specifics
	3	• communicates and presents the project in an understandable but limited fashion
	2	• provides visual and written communication that is lacking in organization and clarity or communication that is minimal
	1	• attempts to communicate, and presents some part of the project
	0	• provides communication that is missing or irrelevant

The following sheet can be used for scoring student projects.

Scoring Sheet for Assessing Student Project

Student Name: _____

Mathematics Course: _____

Instructor's Name: _____ Date: _____

Project Title: _____

Suggested distribution of marks totalling 30

Assessment criteria	Marks	Comments
Design	____/6	
Organization and Visual Presentation	____/6	
Analysis	____/6	
Generalization and Evaluation	____/6	
Communication	____/6	

Total marks: _____/30 = _____ %

Other comments:

Student's comments:

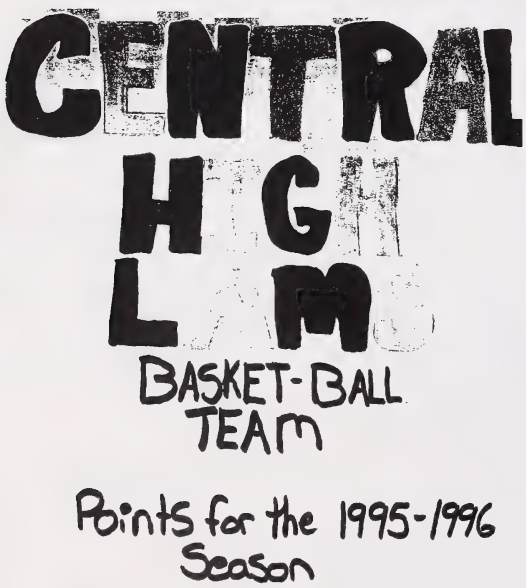
Teacher's signature _____

Student's signature _____

Student Responses for Project begin on page 26.

Student Examples

This response would receive a score of	*21*	
Category	**Marks**	**Scoring Criteria**
Design	4	*The student* • substantially identifies the problem and provides most steps and/or information necessary for conducting the project
Organization and Visual Presentation	5	• chooses correct formats to organize and represent data. All required charts, diagrams, or graphs are presented, but there may be minor errors in presentation
Analysis	4	• analyzes and interprets major portions of the project and data reasonably, but small parts of the analysis are missing or flawed
Generalization and Evaluation	3	• provides some generalizations and interpretations that are weak but lead to a correct inference
Communication	5	• provides detail, communicates and presents the project effectively, but the communication contains a minor flaw



I selected the frequency of the Central High girls team because I play on this team and I was curious how consistent we were through the season. I choose to do a line plot because it would show the trends of the points scored and how well the team did and see the poor games scores that were played and compare them to the top scores. The bar graph was mainly to show the same thing as the line plot but in a different way the line plot is easier to understand and analys it.

Hypothesis - I think towards the end of the end of the season the points will be higher than at the start.

Ending result - yes the points did go higher but it did go lower but not as low as the start of the season.

There is 12 girls on the team. I choose the top scores of the season and compared them for the same 34 games. I realize that 1 girl might have not played as much as the other at one time or one girl had to leave or was hurt. And the the whole team the bottom scores might have been a close game or we played a real toughteam. It would have been better if I could have compare the teams we played but it would be very hard because it was 34 different teams.

Continued

Continued

Stem and leaf Plot

Point Scored in different Games

3	68
4	588
5	368
6	446
7	3355688
8	34444459
9	23368
10	08
11	0

mean, Median, Mode and Range

MEAN - 75.6

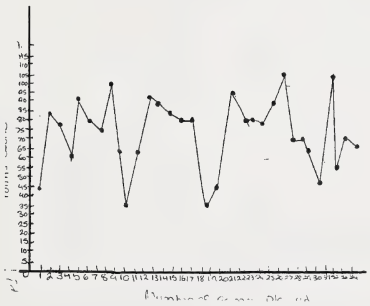
MEDIAN - 78

MODE - 84

RANGE - 74

Points Scored in Central High Lams Basket-Ball games

Points are Joined to show trends



Comparing top 2 players

Player 1 Points	Game	Player 2 Points
26	1	12
13	2	28
32	3	23
18	4	28
34	5	10
11	6	15
28	7	23
20	8	17
13	9	24
18	10	17
15	11	20
26	12	29
18	13	25
16	14	26
24	15	13
28	16	32
14	17	18
10	18	34
20	19	11
22	20	28
27	21	20
32	22	13
18	23	18
13	24	26
28	25	18
17	26	12
19	27	17
28	28	29
22	29	20
21	30	10
23	31	24
18	32	26
19	33	26
20	34	18

Player 1: mean 20.9 P/game; median 20; mode 18; range 24

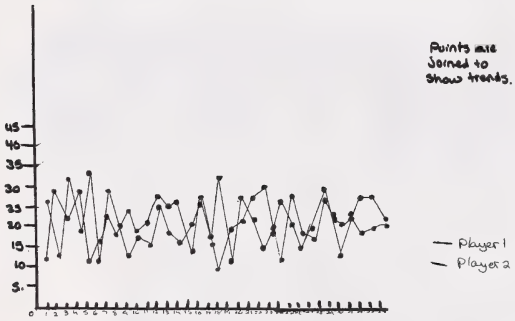
Player 2: mean 20.8 P/game; median 20; mode 18, 26; range 24

Continued

Continued

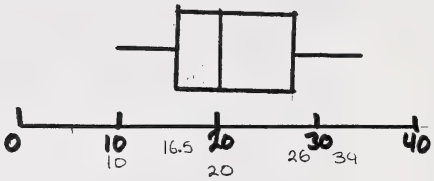
Central High Lams Stats for 34 games played

Comparing top two players

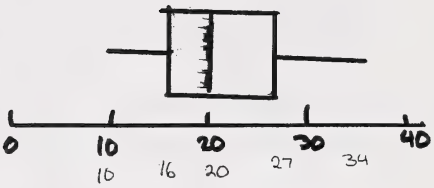


Player 1

Box & wisker plot



Player 2



Continued

Continued

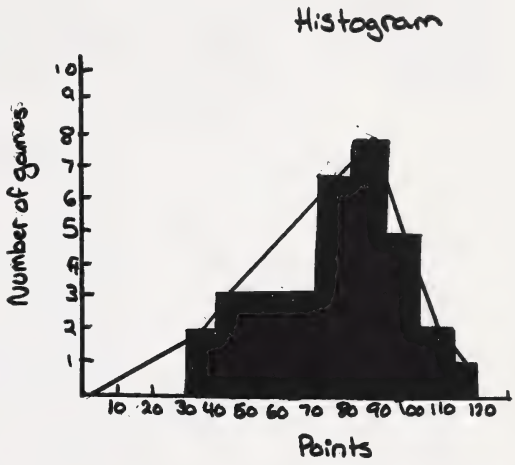
How well did the basket ball team average in the past Season.

I think towards the end of the ~~end~~ Season the points will be higher than at the start.

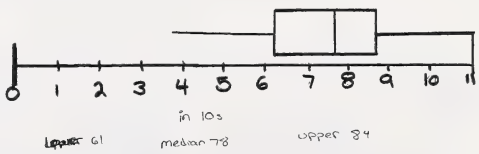
The central High girls basket ball team gather the Scores from the 1995 1996 Season

How well did the team do and what was the average Scole?

Gather the Scores from the past Season and see how consistent the girls team was.



Box and wisker Plot

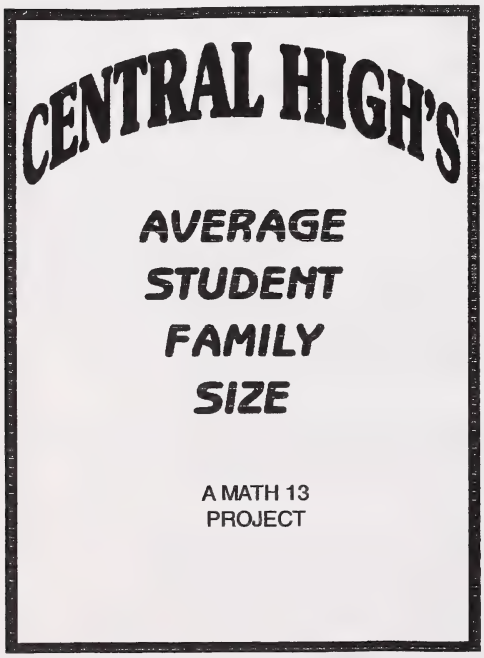


Commentary

The student's

- response contains most steps and information necessary to solve the problem. The inclusion of biases would have enhanced the project design. The statistics and comments related to the top two scores should have been mentioned in the design
- presentation includes graphs that are effective. A minor presentation error occurs in portraying the line graph
- analysis is limited and is supported by appropriate diagrams. The statistical procedures and calculations would have been strengthened by more detail and the avoidance of minor calculation errors
- inferences are weak and disjointed; i.e., "It would have been better if I could have compared the teams we played but it would be very hard because it was 34 different teams"
- communication provides evidence that the project is thought out in an appealing and well-planned manner, although the problem investigated could have been more clearly stated at the onset. The project contains information that is unrelated to the stated problem

This response would receive a score of **20**		
Category	**Marks**	**Scoring Criteria**
Design	5	*The student* • clearly identifies the problem and provides all the steps and information necessary for conducting the project, with a minor error
Organization and Visual Presentation	4	• chooses correct formats to organize and represent data. Most charts, diagrams, or graphs are presented clearly and correctly
Analysis	4	• analyzes and interprets major portions of the project and data reasonably, but small parts of the analysis are missing or flawed
Generalization and Evaluation	3	• provides some generalizations and interpretations that are weak but lead to a correct inference
Communication	4	• communicates and presents the project well in general terms, but the communication lacks in specifics



DESIGN

For my math project I choose the average family size of the students attending Central High School. I selected this topic mostly out of interest. I was curious to find out the average amount of people in a family.

My goal was to pick students randomly avoiding bias. I wanted my findings to be accurate and fair. I achieved this by taking a group of numbers and deciding to go right in picking them I went across the page in picking them randomly. After I had writen these numbers down I took a list of the students in the school and matched the student numbers with the one's I had picked randomly off the group of numbers. I feel this was fair and truthful information.

Before asking the students on the list how large their family was I made a prediction. "I predict that the average family size will be between 4-5 people". I then began to ask the students off the list (30 of them) about their family size.

ORGANIZATION AND VISUAL REPRESENTATION

I chose a frequency table, circle graph and a box-and whisker plot to represent and organize my information. I also included a bar graph

Continued

Continued

FREQUENCY TABLE
AVERAGE FAMILY MEMBERS OF STUDENTS

NUMBER OF PEOPLE IN FAMILY	TALLY	FREQUENCY
3	I	1
4	~~IIII~~ III	8
5	III ~~IIII~~ ~~IIII~~	13
6	~~IIII~~ I	6
8	II	2

Continued

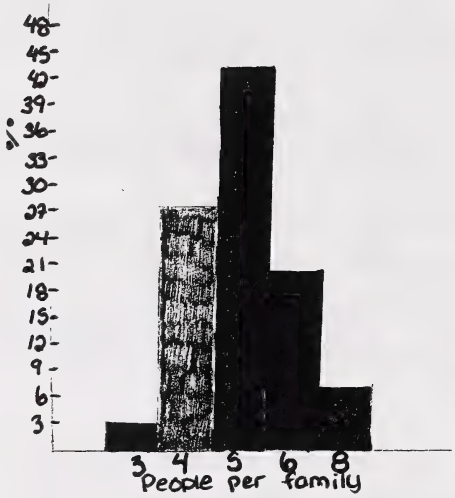
Continued

BOX AND WHISKER PLOT
OF AVERAGE FAMILY MEMBERS OF STUDENTS

CIRCLE GRAPH
AVERAGE FAMILY MEMBERS OF STUDENTS

People(per family)

Average Family Members
Of Students



ANALYSIS

MEAN = 5.07

MEDIAN = 5

MODE = 5

RANGE = 5

As you can see I analized my information finding out the average family size is about five people. I also concluded the median. Then I found the most often number of people in families was again five. As the range was too. Most people's families contained of five people in sum.

CONCLUSION

In conclusion I found my prediction was close but I was a little off as it was 4-5 people. I found it ended up to be between 5-6 people.

Overal I think my project turned out fairly well. It was not bias and the graph's and information were accurate. Although I found it hard to find some of the students on the list. Which was a difficulty I over came.

For further recommendations for further investigations I would gather more information from different schools and towns.

I was pleased with the outcome and satisfied with my findings.

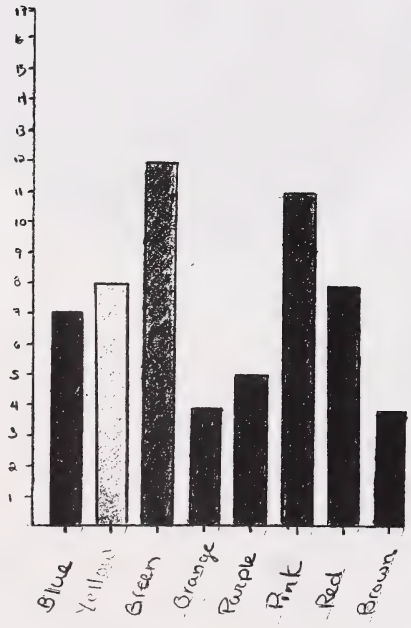
Continued

Continued

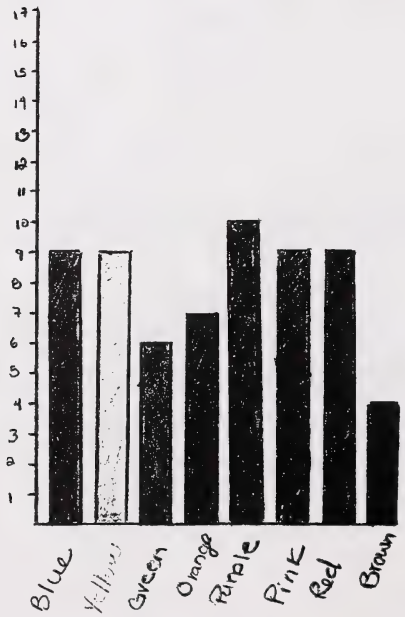
Commentary
The student's • project design is clear and accurate, but lacks detail in identifying the sample • graph and charts are presented clearly and correctly for the most part, but some charts and graphs contain minor errors: –the box-and-whisker plot does not have a proper scale –the bar graph is in percent and the chart with raw data is not clearly linked • analysis of mean, median, mode, and range are correct, but reasons could have been included for choices of analysis and other topics, such as quartile values and extremes • generalizations are correct but would have warranted a higher assessment had they been more complete in terms of accuracy, support, and detail • communication is presented in a reasonable manner, using general terms throughout the paper

This response would receive a score of **15**		
Category	**Marks**	**Scoring Criteria**
Design	3	*The student* • reasonably identifies the problem although some of the steps and information are flawed or missing
Organization and Visual Presentation	3	• chooses correct formats to organize and represent data. Some charts, diagrams, or graphs contain major errors or are missing
Analysis	3	• makes a reasonable attempt to analyze the data, but the analysis contains major errors or lacks significant parts
Generalization and Evaluation	3	• provides some generalizations and interpretations that are weak but lead to a correct inference
Communication	3	• communicates and presents the project in an understandable but limited fashion

BOX #1



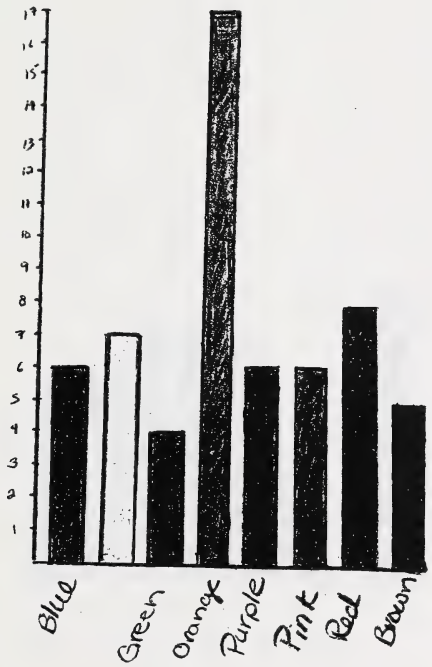
BOX #2



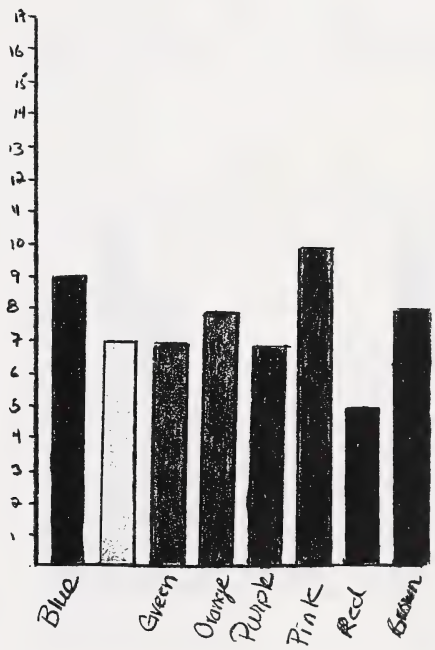
Continued

Continued

BOX #3



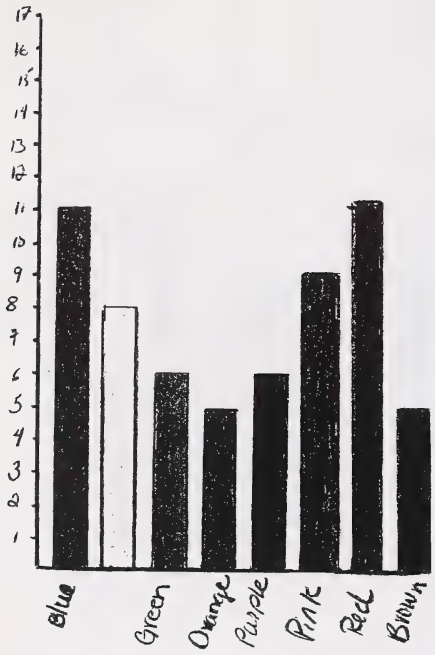
BOX #4



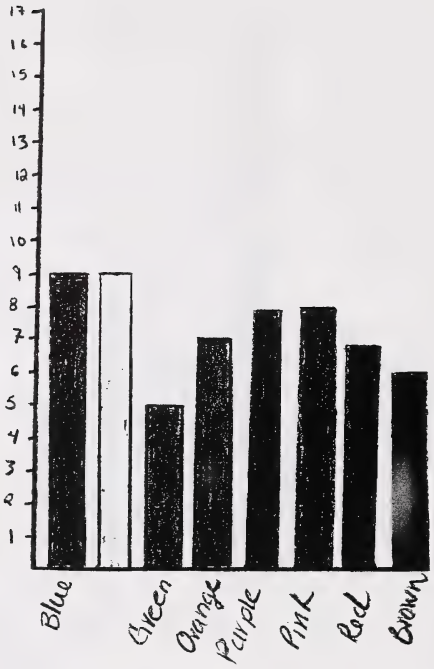
Continued

Continued

BOX #5



BOX #6



Continued

Continued

SMARTIES- # OF SMARTIES PER BOX

COLOUR	MEAN	MEDIAN	MODE	RANGE
BLUE	8.5	9	9	5
	8	8	7/8/9	2
GREEN	6.7	6	6	8
ORANGE	8	7	7	13
PURPLE	7	6.5	6	5
PINK	8.8	9	9	5
RED	8	8	8	6
BROWN	5.3	5	4/5	4

SMARTIES

Stem and Leaf Plot

0	67999
1	1

0	56678
1	0

0	778899
1	

0	6899
1	01

0	45667
1	9

0	57889
1	1

0	45778
1	7

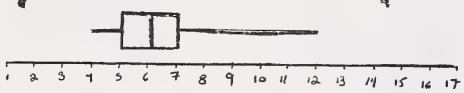
0	445568
1	

Continued

Continued

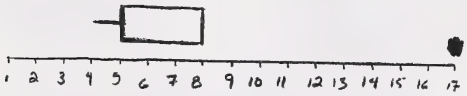
SMARTIES

GREEN



IQR=2

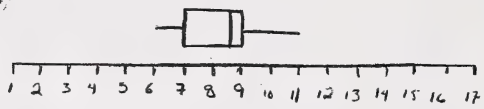
ORANGE



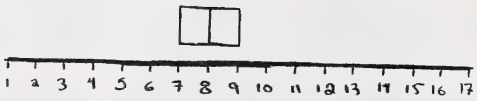
IQR=3

SMARTIES

BLUE



IQR= 2



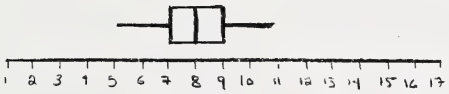
IQR= 2

Continued

Continued

SMARTIES

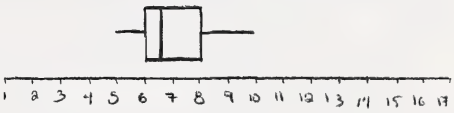
RED



IQR=2

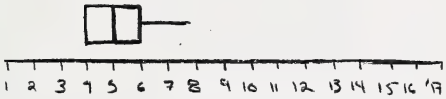
SMARTIES

PURPLE



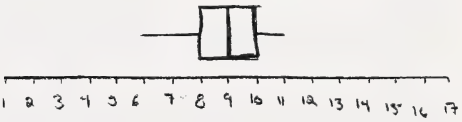
IQR=2

BROWN



IQR=2

PINK



IQR=2

Continued

Continued

SMARTIES

I conducted this experiment by buying several boxes of Smarties from differant stores in Hardisty and Sedgewick. I sorted each box by colour, recorded the results, added the boxes together, and used that information to do Mean, Median, Mode, Range, Box and Whisker Plots, and Probability charts.

From this experiment, I had hoped to find out if the number of each colour varied from box to box. I thought that there would be more brown Smarties than any other colour; but it turned out that the number of brown was much lower than the other colours. There was a pretty even spread of colours, but the brown stood out most.

SMARTIES

COLOUR	BOX #1	BOX #2	BOX#3	BOX #4	BOX #5	BOX #6	TOTAL BOXES
BLUE	7	9	6	9	11	9	51
YELLOW	8	9	7	7	8	9	47
GREEN	12	6	4	7	6	5	40
ORANGE	4	7	17	8	5	7	49
PURPLE	5	10	6	7	6	8	42
PINK	11	9	6	10	9	8	53
RED	8	9	8	5	11	7	48
BROWN	4	4	5	8	5	6	32
TOTAL #	59	63	59	61	61	59	362

PROBABILITY

The colours are pretty much evenly distributed, but the brown smarties stand out because the ratio of brown to all is much less than the others.

The Probability of drawing a

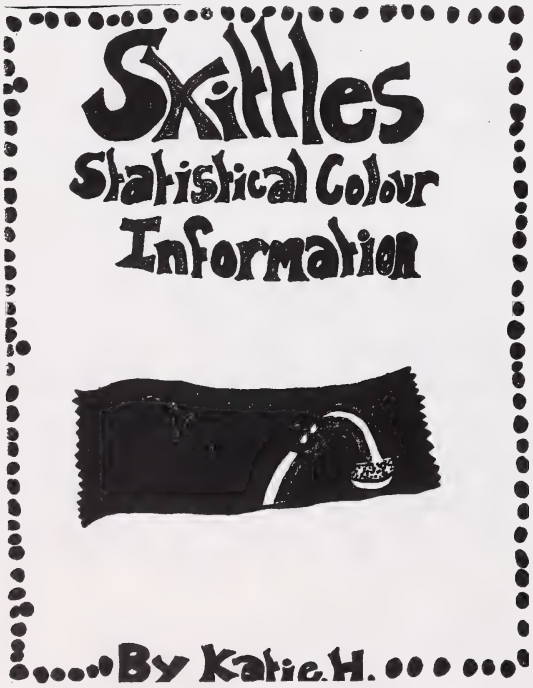
BLUE:	51/362	14%
YELLOW:	47/362	13%
GREEN:	20/181	11%
ORANGE:	49/362	14%
PURPLE:	21/181	11%
PINK:	53/362	15%
RED:	24/181	13%
BROWN:	16/181	9%

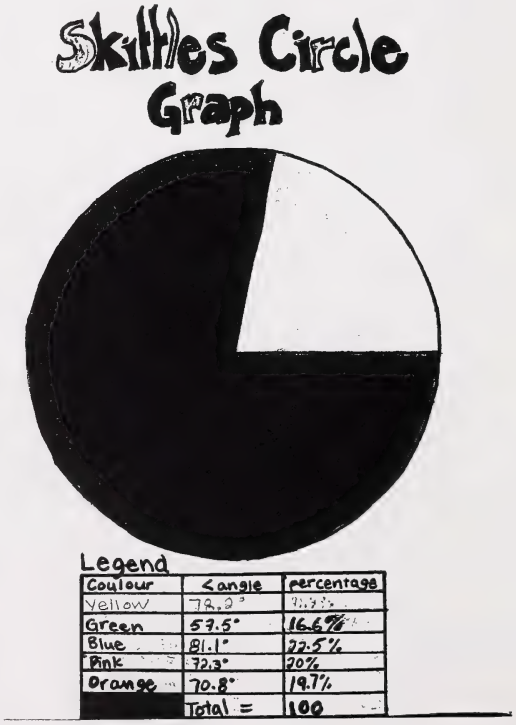
Continued

Continued

Commentary
The student's • response identifies some of the steps needed to carry out the project, but steps are flawed or contain errors (i.e., the lack of clear questions, failure to identify the population and sample size, and failure to recognize a bias, in that only stores in Hardisty and Sedgewick were selected) • presentation includes correct formats to represent data, but commentaries are not defended and major errors occur (i.e., not labelling graphs) • analysis is limited and measurements are missing or incorrect (e.g., extremes, quartile, and outliers are incorrect) • generalization is not developed and is only partially linked to a hypothesis • communication is adequate but limited in depth; the response relies on the reader's interpretation of the visuals presented

This response would receive a score of	*11*	
Category	**Marks**	**Scoring Criteria**
Design	2	*The student* • provides an unclear identification of the problem and process; response may contain steps that are fragmented or missing
Organization and Visual Presentation	2	• presents a few charts, diagrams, or graphs, some of which are flawed
Analysis	3	• makes a reasonable attempt to analyze the data, but the analysis contains major errors or lacks significant parts
Generalization and Evaluation	2	• attempts to make generalizations and interpretations that are appropriate but flawed
Communication	2	• provides visual and written communication that is lacking in organization and clarity or communication that is minimal





Continued

Continued

Frequency Chart

COLOUR	Tally	Frequency
Yellow		53
Green		39
Blue		55
Pink		49
Orange		48
	Total =	244

*note → all bags together

Individual bags Frequency Tables

Bag #1

Colour	Tally	Frequency
Yellow		14
Green		9
Blue		14
Pink		13
Orange		10
	Total	60

Bag #2

Colour	Tally	Frequency
Yellow		16
Green		10
Blue		13
Pink		11
Orange		10
	Total	60

Colour	Tally	Frequency
Yellow		13
Green		6
Blue		17
Pink		16
Orange		8
	Total	60

Bag #3

Colour	Tally	Frequency
Yellow		10
Green		14
Blue		11
Pink		9
Orange		15
	total	60

Bag #4

Continued

Continued

MEAN, MEDIAN, MODE, RANGE.

14 16 13 10 — Yellow

Mean → 13.25 Range → 6
Median → 11.5
Mode → 13.5

6, 9, 10, 14, — Green

Mean → 9.75 Range → 8
Median → 9.5
Mode → 9.5

11, 13, 14, 17 — Blue

Mean → 13.75 Range → 6
Median → 13.5
Mode → 13.5

Mean, Median, Mode, Range.

Continued...

9, 11, 13, 16 — Pink

Mean → 12.25 Range → 7
Median → 12
Mode → 9.5

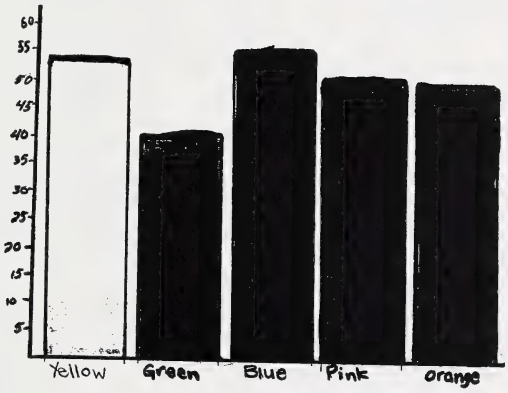
8, 10, 10, 15 — Orange

Mean → 10.75 Range → 7
Median → 10
Mode → 10

Continued

Continued

Bar Graph



Number of skittles per colour in four bags. 244 skittles.

Box and Whisker Plot

Continued

Continued

Written Presentation

We chose the topic "Skittles" because it's
Something you could use many different
Charts to show your data on. And it
worked very effectively.
I think that the circle graph is the
most effective way to show our data
because you don't have to read very
much, the information is all right there.
This statistics experiment worked very
effectively we found that blue is the most
common skittle found in skittle bags following
in order, yellow, pink, orange, green.
Each skittle bag has 60 skittles in it.
To further this experiment someone
could choose a different type of skittles,
ours were, "Tropical Fruit".
This, evaluation was very effective and
our anticipation was that pink would be
the most common skittle but it wasn't.

Commentary

The student's

- design includes an unclear identification of the question and population through visuals as well as throughout the process; the steps taken are redundant
- presentation includes graphs that lack labels and box-and-whisker plots that lack in accuracy
- analysis includes calculations of measures of central tendencies and an attempt to justify or analyze the results. The analysis of quartiles and extremes is missing
- generalization is associated with a hypothesis that is appropriate, but the project would have been strengthened by direct inferences based on the project's results
- project contains visual and written communication that is minimal, and visuals rely on the reader's interpretation as to why they are included

This response would receive a score of 7		
Category	**Marks**	**Scoring Criteria**
Design	1	*The student* • makes a significant start that shows some understanding of the process or of the information related to the problem
Organization and Visual Presentation	1	• makes a significant start in presenting charts, diagrams, or graphs related to the problem
Analysis	1	• makes a weak attempt to start an analysis or calculation relevant to the analysis
Generalization and Evaluation	2	• attempts to make generalizations and interpretations that are appropriate but flawed
Communication	2	• provides visual and written communication that is lacking in organization and clarity or communication that is minimal

TEST SCORES

ON MATH 13

QUIZ

MEAN
MODE
PICTO GRAPH
FREQUENCY
MODE
BAR GRAPH
BAR CHART

FREQUENCY CHART

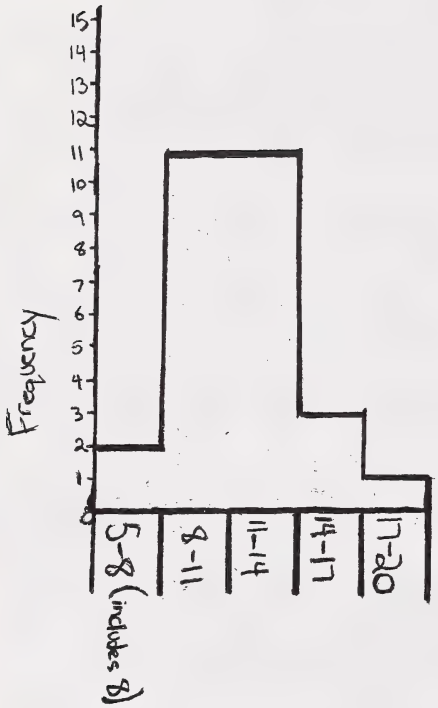
Test Scores	Tally	Frequency
5-8	II	2
8-11	~~IIII~~ ~~IIII~~ I	11
11-14	~~IIII~~ ~~IIII~~ I	11
14-17	III	3
17-20	I	1

(5-8 includes 8)

Continued

Continued

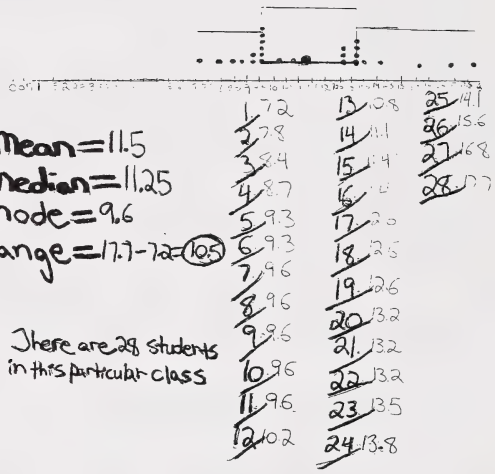
HISTOGRAM



Conclusion:

On this particular Math 13 test most of the people got over 50% so 10 and over out of 20 possible marks. I can predict that $\frac{19}{28}$ people got over the 50% mark while $\frac{9}{28}$ people failed the particular test.

Box-and-Whisker Plot



Mean = 11.5
Median = 11.25
Mode = 9.6
Range = 17.7 − 7.2 = 10.5

There are 28 students in this particular class

Continued

Continued

Commentary
The student's • project shows an understanding of a process to determine the frequency of a score, but the process and population used to answer the question is lacking and suspect • presentation shows a significant start, but intervals on the frequency chart and histogram are incorrect and improperly labelled; as well, not enough formats are included • analysis is minimal and shows a weak attempt to interpret data • conclusion shows an attempt to generalize by predicting results, but any substantial or appropriate generalizations are missing or flawed • communication is minimal and incomplete

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